Table of Contents

Subject **Page**

ME 7.2 2
Objectives of the Module 2
Purpose of the System 3
System Components 4

Fuel System 5
Evaporative 6
Supply and Injectors 8

Exhaust and Catalysts 9

Input Signals/Components 11
Camshaft Position Sensors. 11
Hot Film Air Mass Sensor 12
Integrated Ambient Barometric Pressure Sensor. 13
Radiator Outlet Temperature Sensor 14
Road Speed Signal. 14
MFL Cruise Control Data 15
CAN bus Topology 16

Output Control Functions/Components 17
Fuel Pump Relay Control 17
E Box Fan Control 17
Secondary Air Injection 18
Auxiliary Fan Control 19

Integral Electronic Throttle System (EML) 20

VANOS 24

Review Questions 42

ME 7.2

Model: E39/E38/E53 with M62TU Engine

Production Date: 99 MY - Present

Manufacturer: Bosch

Pin Connector: 134 Pins - 5 Modular Connectors

Objectives of the Module

After completing this module, you will be able to:

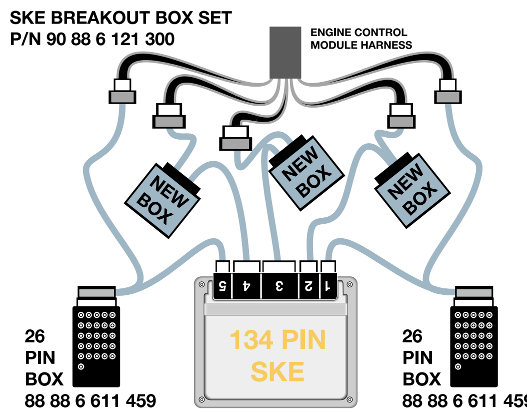
- Explain what the “ME” Designation Identifies
- Understand the EDK Operation
- Explain How the ECM Monitors LDP Pump Operation
- Describe the Non-Return Fuel Rail System
- Understand the Purpose of the Radiator Outlet Temperature Sensor
- List What Two Systems Affect the Fuel Pump Operation
- Understand PWG “Failsafe” Operation
- Describe How the Active Hall Sensors Monitor the Camshafts
- Demonstrate a VANOS Adjustment

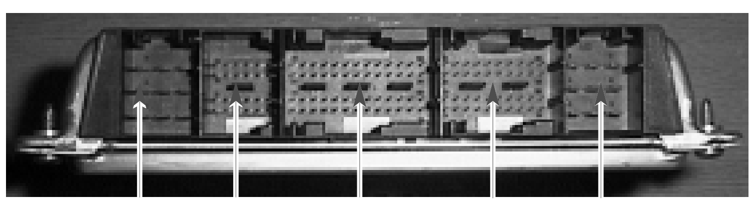
ME 7.2 ENGINE MANAGEMENT SYSTEM

Purpose of the System

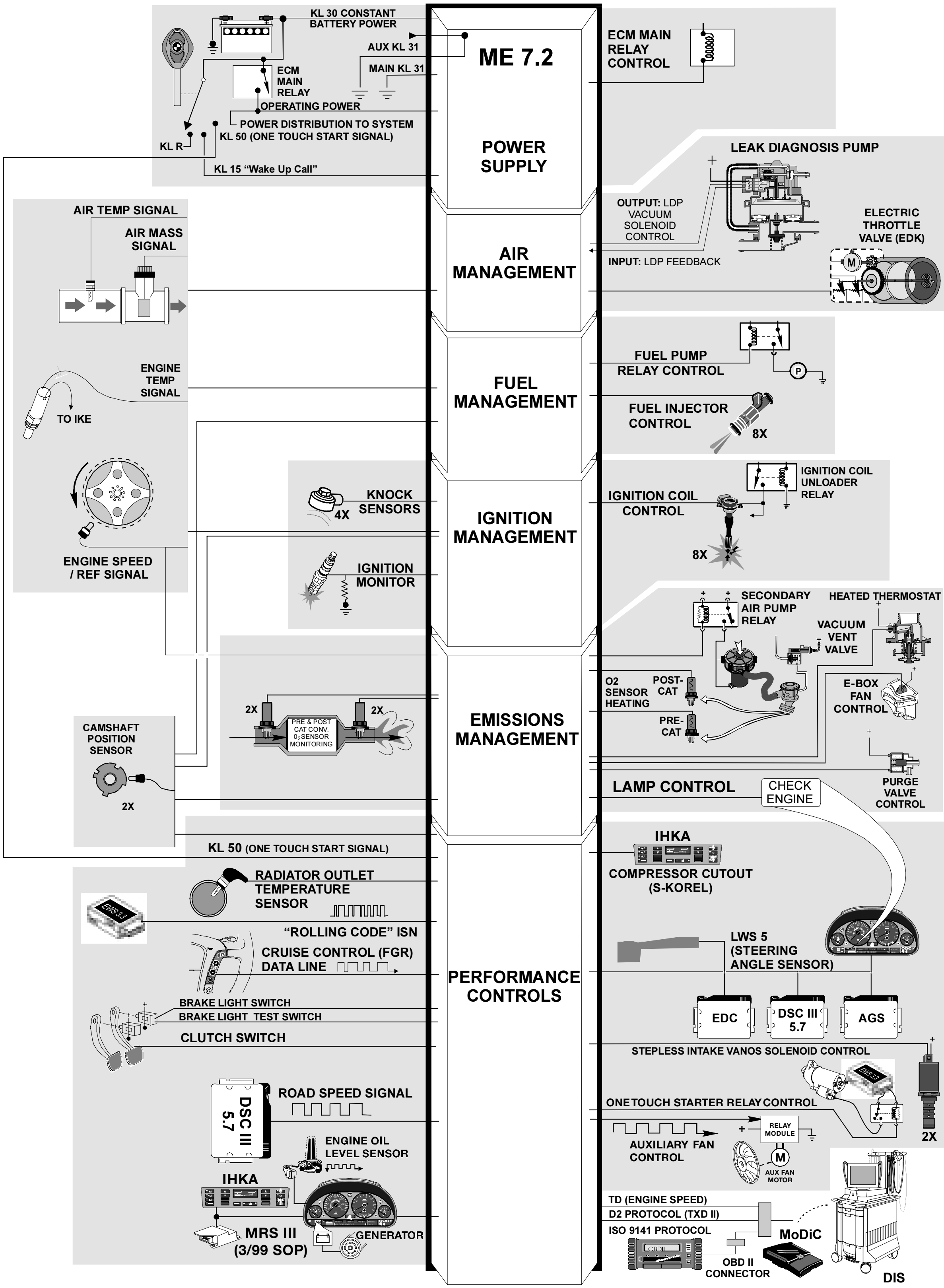
ME 7.2 replaces M5.2.1 for all 8 cylinder engine applications. The “ME” designation identifies the system as “M = Motronic, E = EML.

- Manufactured by Bosch to BMW specifications
- 134 pin SKE (standard shell construction) control module located in E box
- Diagnostic communication protocol (KWP2000)
- Uses break-out box set (P/N 90 88 6 121 300)
- Integral EML throttle control system
  - monitors an interior installed PWG
  - actuates an electric throttle valve (EDK)
- Integral Cruise control functionality
  - monitors cruise control requests
  - monitors brake pedal and clutch switches
  - carries out throttle control directly via EDK
- Carries out DSC III torque reduction requests.
- VANOS control
- Integrated altitude sensor
- Integrated temp sensor for monitoring E box temperatures
- Control of E-box fan
- One touch engine start control
- Oxygen Sensor heating
- Engine overrev & Max speed limitation
- Active Hall sensor for camshaft position monitoring
- Single speed secondary air injection system
- Electrically heated coolant system thermostat (same function as previous M62 engine)
- Longlife spark plugs
- IHKA Auxiliary Fan control





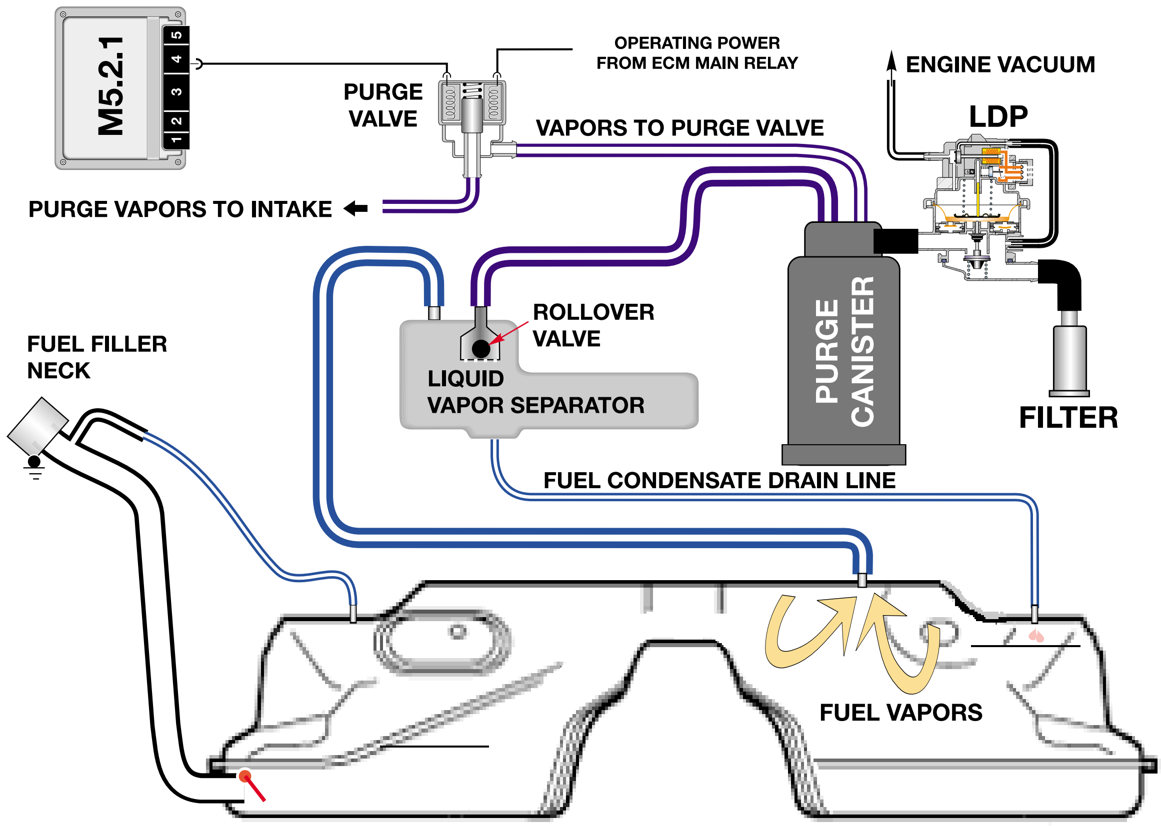
System Components: INPUTS - PROCESSING - OUTPUTS



LEAK DIAGNOSIS PUMP (LDP SYSTEM)

Starting with the 98 model year the LDP method of evaporative system leak detection was introduced on E38 and E39 vehicles.

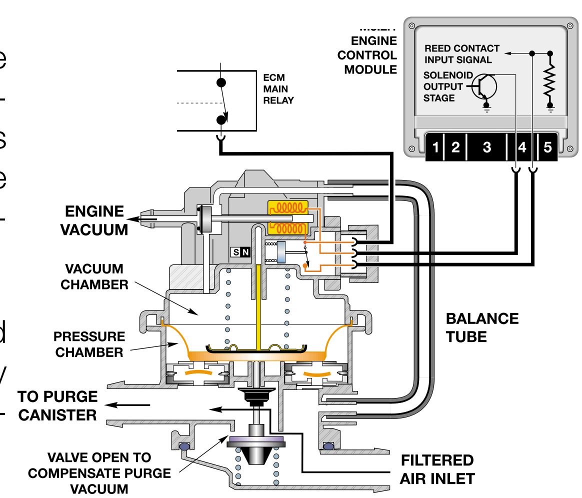
Components:



Functional Overview:

- The function of the LDP is to pressurize the fuel tank and the evaporative emission system to detect leaks. The pump also serves as the fresh air inlet path during normal purge operation when leak diagnosis is not occurring.

- The pump contains a spring loaded diaphragm which is moved up and down by solenoid controlled engine vacuum to generate the air pressure



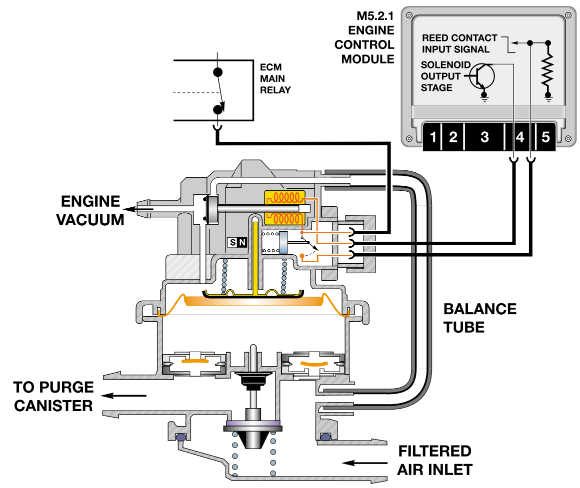
- During a leak test, the normally open vent valve is sprung closed to retain the built up pressure.

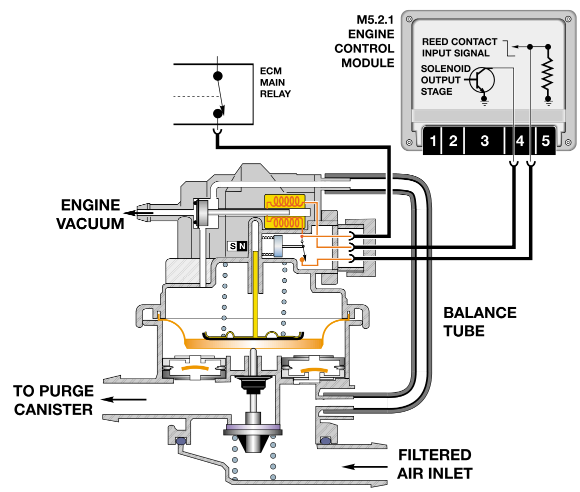
- The purge valve(s) are also sprung closed to seal the system.

- The reciprocation of the diaphragm pulls in filtered ambient air and pumps it into the fuel system via the purge canister as the vacuum supply is repetitively opened and closed electrically by the ECM.

- The ECM monitors the diaphragm movement through a reed contact feedback signal and compares it to its activation output frequency of the vacuum solenoid in the LDP.

- As the pump continues to operate the diaphragm begins to slow down against the built up pressure in the system. The time delay between the vacuum solenoid activation and the reed contact feedback is the basis for leak detection.





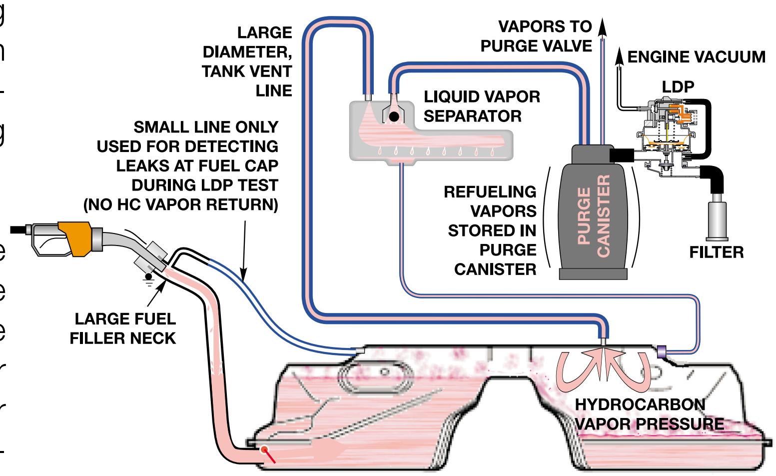
- If the reed contact feedback signal slows down considerably this indicates the pressure is being held by the system and no leaks are present.

- If the reed contact feedback signal is slowed down but not to the satisfaction of a sealed system the ECM will determine a small leak is present.

- If there is no delay in the feedback signal the ECM determines a large leak is present (ie: missing fuel filler cap).

ON-BOARD REFUELING VAPOR RECOVERY (ORVR)

The ORVR system recovers and stores hydrocarbon fuel vapor that was previously released during refueling. Non ORVR vehicles vent fuel vapors from the tank venting line back to the filler neck and in many states reclaimed by a vacuum receiver (Stage II) on the filling station's fuel pump nozzle.



When refueling, the pressure of the fuel entering the tank forces the hydrocarbon vapors through the tank vent line to the liquid/ vapor separator, through the rollover valve and into the charcoal canister.

The HC is stored in the charcoal canister, and the system can then "breathe" through the LDP and the air filter.

ON BOARD DIAGNOSTICS II

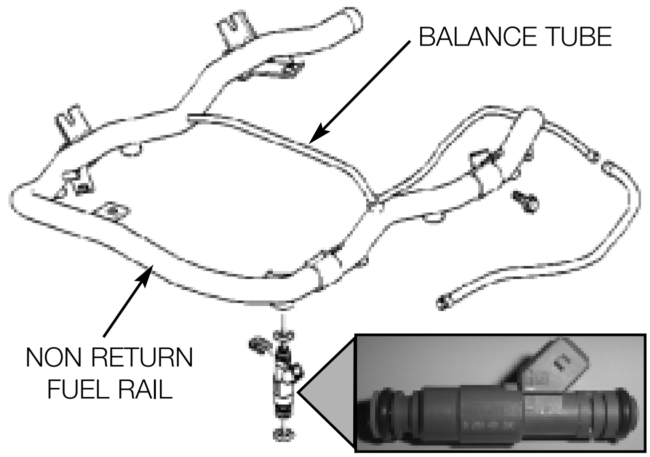
OBD II requires that all vehicle manufacturers comply with extensive fault monitoring capabilities for all emission related drivetrain control systems. These systems; ECM, AGS and EML must monitor their components electrically and monitor for plausible mechanical engine function. Additionally, OBD II provides a separate Diagnostic Link Connector (DLC) located in the vehicle interior to access OBD II fault codes with an aftermarket scan tool. BMW center technicians utilize BMW diagnostic equipment and software (DIS/MoDiC) to interface with all vehicle control systems.

FUEL INJECTORS

The M62 TU utilizes new fuel injectors manufactured by Bosch. The injector pintle consists of a two ball seat.

The ball seat design provides a tight seal when the injector is closed preventing HC formation in the intake.

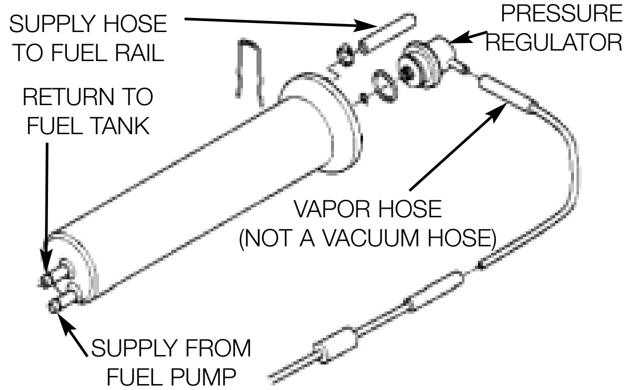
The injectors have an ohmic value of 15.5 ohms.



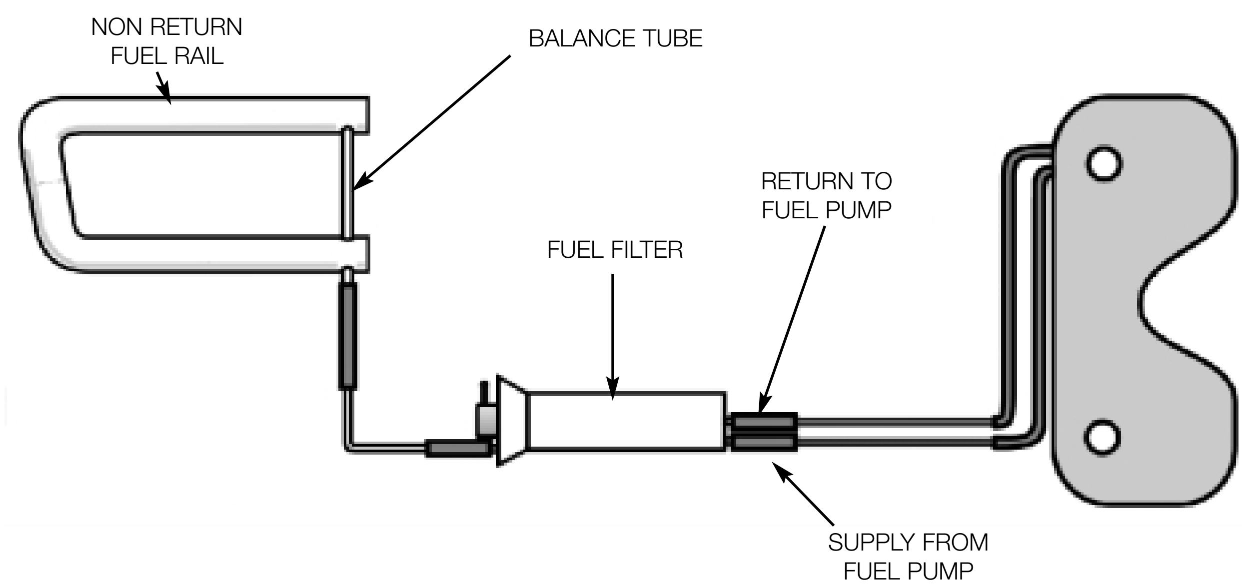
NON RETURN FUEL RAIL SYSTEM

The M62 TU introduces a new method of meeting Running Loss Compliance without the use of the familiar 3/2 way running loss valve.

The regulated fuel supply is controlled by the fuel pressure regulator integrated in the fuel filter. A fuel return line is located on the fuel filter.



The system provides even fuel distribution to all fuel injectors due to a balance tube connecting the feed with the end of the fuel rail. The new fuel rail does not have a fuel return line.

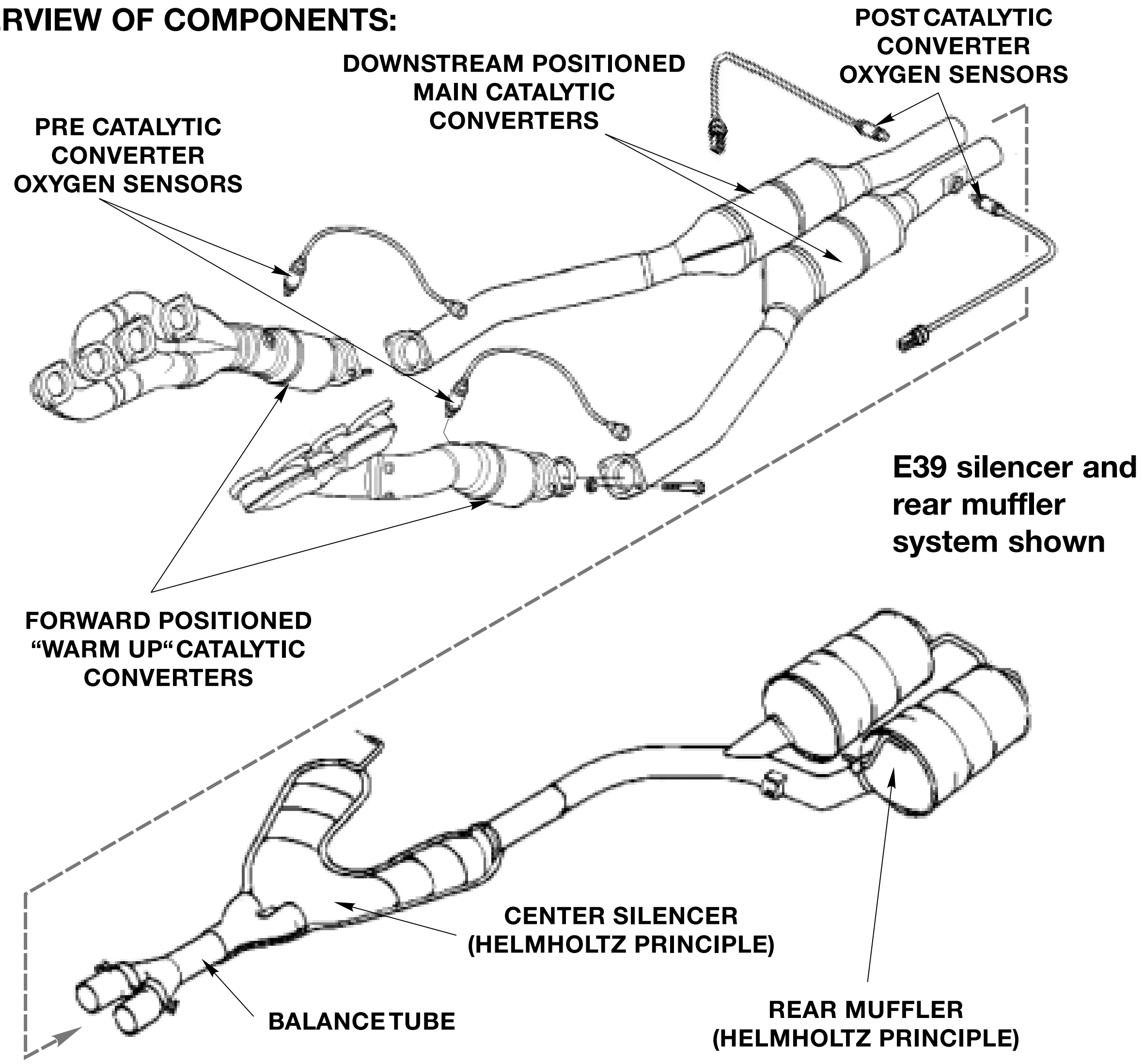


M62 TU EXHAUST SYSTEM

The M62 TU is equipped with two additional catalytic converters known as "warm-up converters". This configuration positions the forward mounted warm-up catalytic converters closer to the hot exhaust gasses immediately exiting the combustion chambers. The closer location heats the catalytic converters to the point of light-off faster than previous systems. Earlier light-off reduces cold start emissions by allowing the gas conversion (HC to H2O, CO to CO2 and NOx by reduction to N2 and O2) to occur more rapidly just after cold start.

The system also contains two main catalytic converters. The main exhaust gas conversion process occurs further downstream in the main catalytic converters.

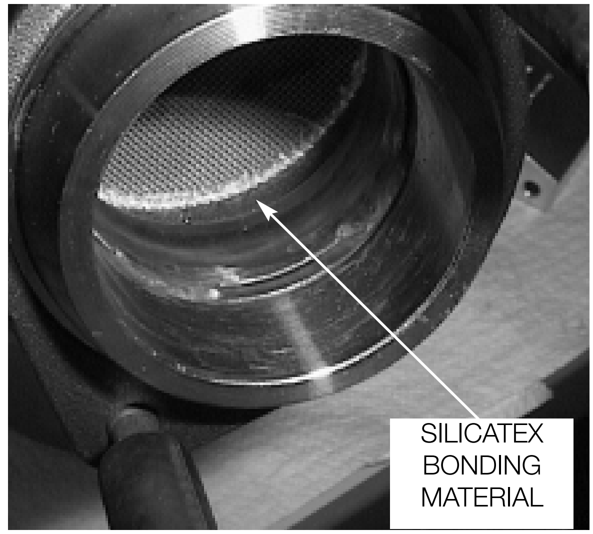
OVERVIEW OF COMPONENTS:

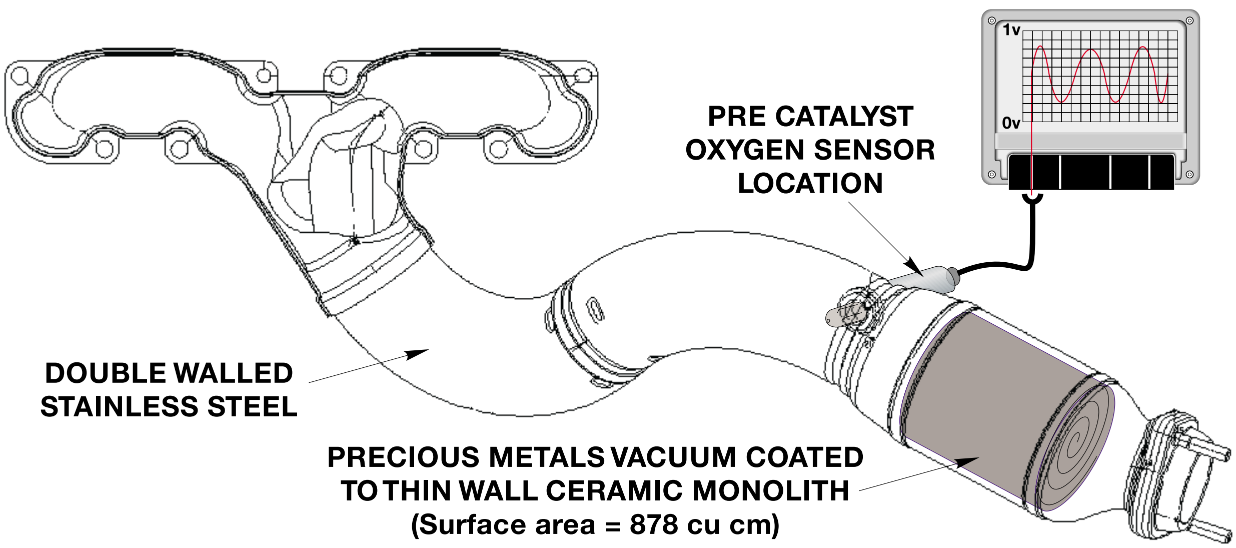


The forward mounted warm-up catalytic converters are made of thin-wall ceramics. They are mounted in a pliable material called silicatex which isolates them from vibrations ensuring a long service life.

For their relatively small size, the catalyst volume of 878 cm^3 provides a large conversion surface area. Use of the thin-wall ceramic design also minimizes exhaust back pressure.

Both pre-catalytic converter oxygen sensors are positioned forward of each warm-up catalyst.





The Bosch LSH 25 oxygen sensors are carried over from the M62 engine and provide the familiar "swinging" voltage signal (0.2 - max lean to 0.8 - max rich) representing oxygen content in the exhaust gas.

The main catalytic converters are also made of thin-wall ceramics. The post catalytic converter oxygen sensors are positioned just behind the main catalytic converters to monitor the catalytic converter function.

The pipes of the exhaust system up to the rear main catalytic converters are made from dual wall stainless steel. This design insulates exhaust noise as well as insulating the thermal energy in the hot exhaust gasses to light-off the converters as quickly as possible.

INPUT SIGNALS/COMPONENTS

CAMSHAFT POSITION SENSORS

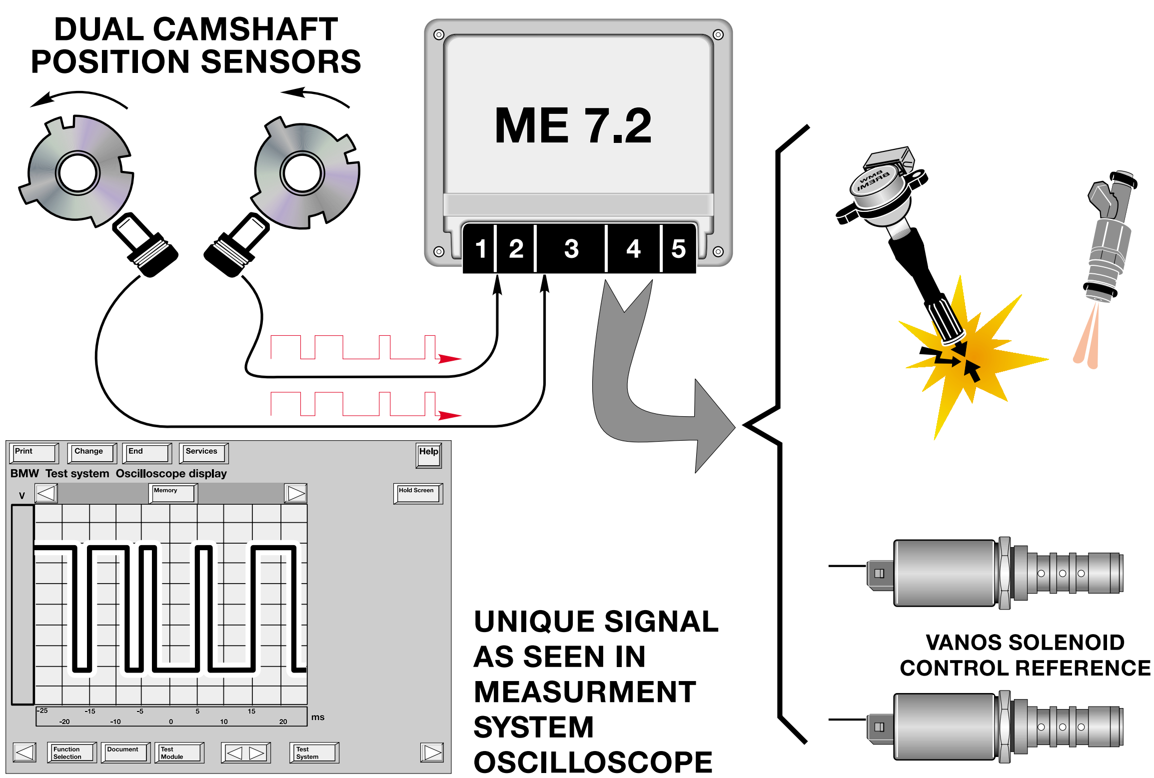
Located on the upper timing case covers, the camshaft position sensors monitor the position of the camshafts to establish start of ignition firing order, set up sequential fuel injection triggering and for accurate camshaft advance-retard (VANOS) timing feedback.

Each intake camshaft's advance-retard angles are adjusted simultaneously yet independently. For this reason ME 7.2 requires a camshaft position sensor on each cylinder bank for accurate feedback to monitor the VANOS controlled camshaft positioning.

The sensors are provided with operating power from the ECM relay. The sensors produce a unique asymmetrical square-wave signal representative of the impulse wheel shape. The sensors are new in the fact that they are "active" hall effect sensors. Active hall sensors provide:

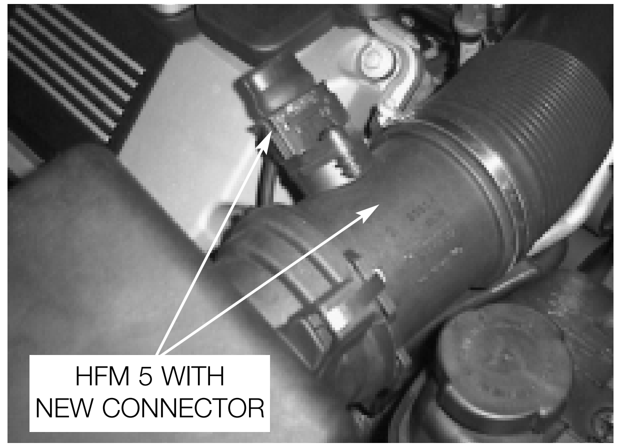
- low signal when a tooth of the camshaft impulse wheel is located in front of the sensor
- high signal when an air gap is present.

The active hall sensors supply a signal representative of camshaft position even before the engine is running. The ME 7.2 determines an approximate location of the camshafts positions prior to engine start up optimizing cold start injection (reduced emissions.)

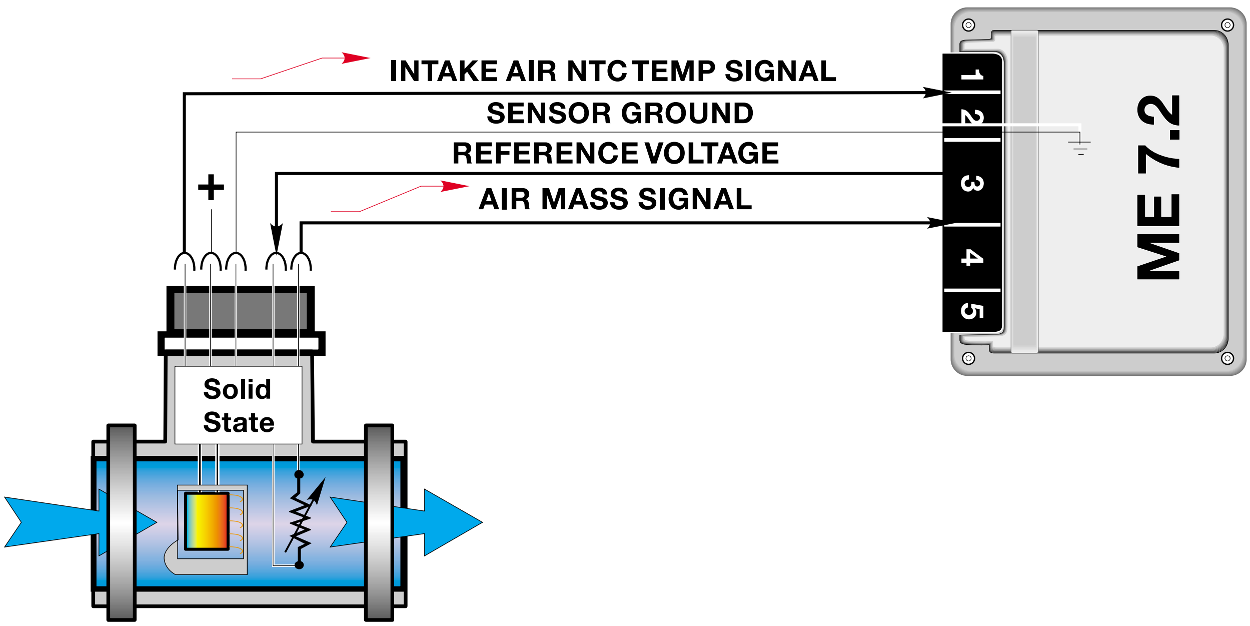


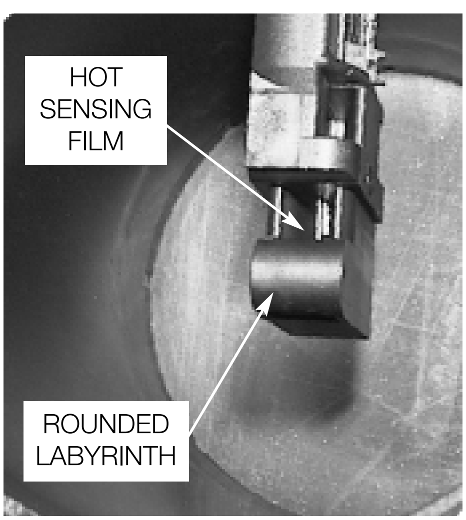
HOT FILM AIR MASS SENSOR (HFM 5)

The M62 TU is equipped with a new Hot Film Air Mass Sensor identified as HFM 5. It is a combined air mass/intake air temperature sensor. The separate intake air temperature sensor is no longer used on the M62 TU.



The HFM 5 is provided with operating power from the ECM relay. Based on calculated intake air mass, the HFM 5 generates a varying voltage between 0.5 and 4.5 volts as an input signal to the ME 7.2





An additional improvement of the HFM 5 is that the hot film element is not openly suspended in the center bore of the sensor as with previous HFMs. It is shrouded by a round fronted plastic labyrinth which isolates it from intake air charge pulsations.

This feature allows the HFM to monitor and calculate the intake air volume with more accuracy. This feature adds further correction for calculating fuel injection “on” time (ti) which reduces emissions further.

INTEGRATED AMBIENT BAROMETRIC PRESSURE SENSOR

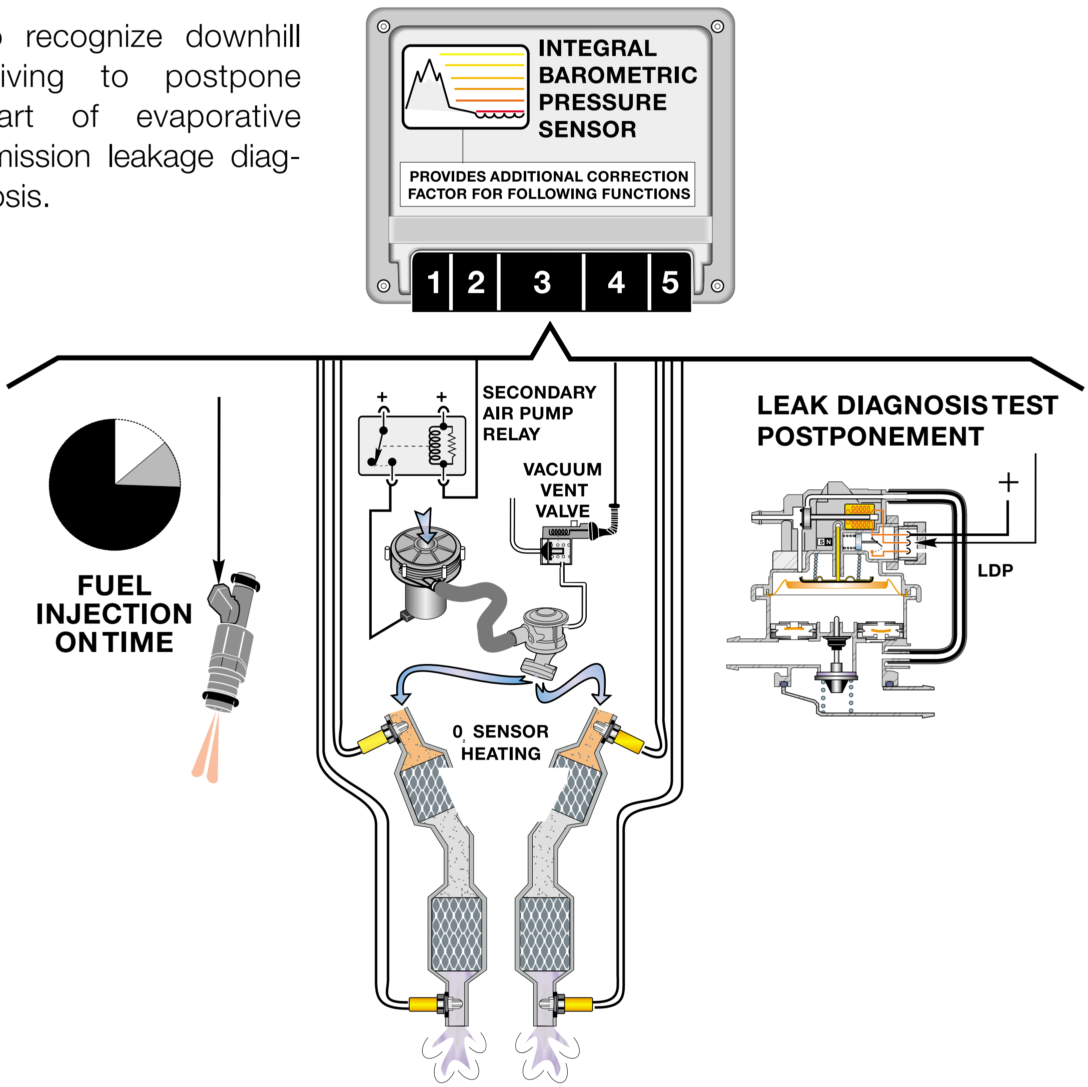
The ME 7.2 Control Module contains an integral ambient barometric pressure sensor. The sensor is part of the SKE and is not serviceable. The internal sensor is supplied with 5 volts. In return it provides a linear voltage of approx. 2.4 to 4.5 volts representative of barometric pressure (altitude).

The ME 7.2 monitors barometric pressure for the following reasons:

- The barometric pressure signal along with calculated air mass provides an additional correction factor to further refine injection "on" time.

- Provides a base value to calculate the air mass being injected into the exhaust system by the secondary air injection system. This correction factor alters the secondary air injection "on" time, optimizing the necessary air flow into the exhaust system.

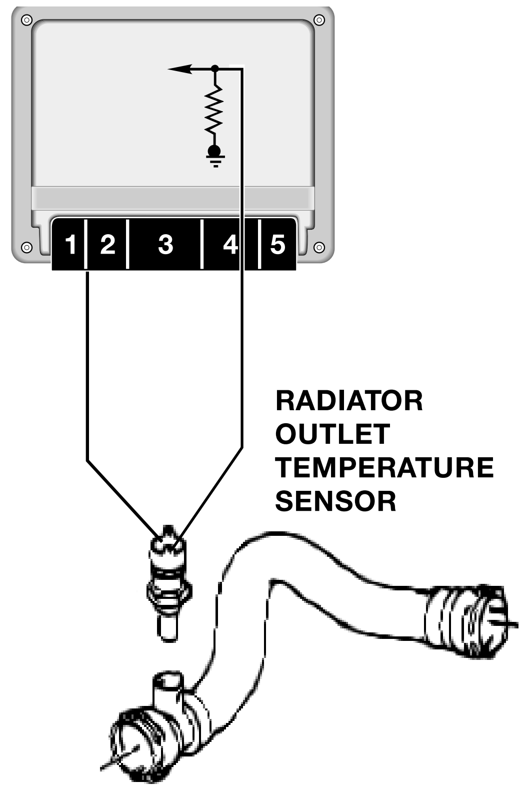
- To recognize downhill driving to postpone start of evaporative emission leakage diagnosis.



RADIATOR OUTLET TEMP SENSOR

The ME 7.2 uses an additional water temperature sensor located on the radiator outlet.

ME 7.2 requires this signal to monitor the water temperature leaving the radiator for precise activation of the IHKA auxiliary fan.

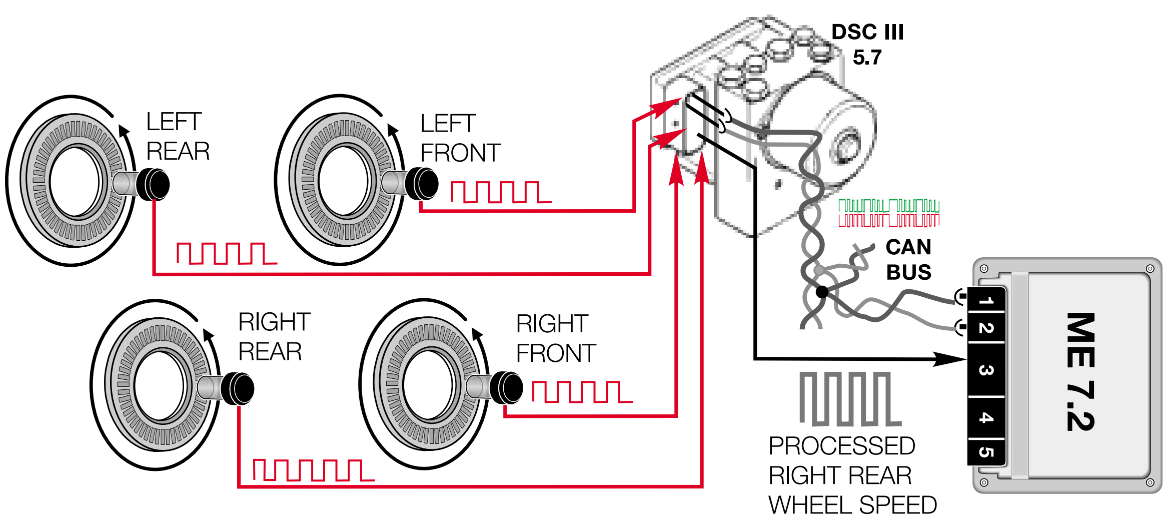


DSC III - ROAD SPEED SIGNAL

ME 7.2 receives the road speed signal directly from the DSC III control module for maximum vehicle speed management. The DSC control module provides a processed output of the right rear wheel speed sensor as a digital square wave signal. The frequency of the signal is proportional to the speed of the vehicle (48 pulses per one revolution of the wheel).

The cruise control function (FGR) of the ME 7.2 also monitors vehicle speed from the redundant vehicle speed CAN bus signal. The CAN bus speed signal is provided by the DSC III control module and based on the combined average of both front wheel speed signals.

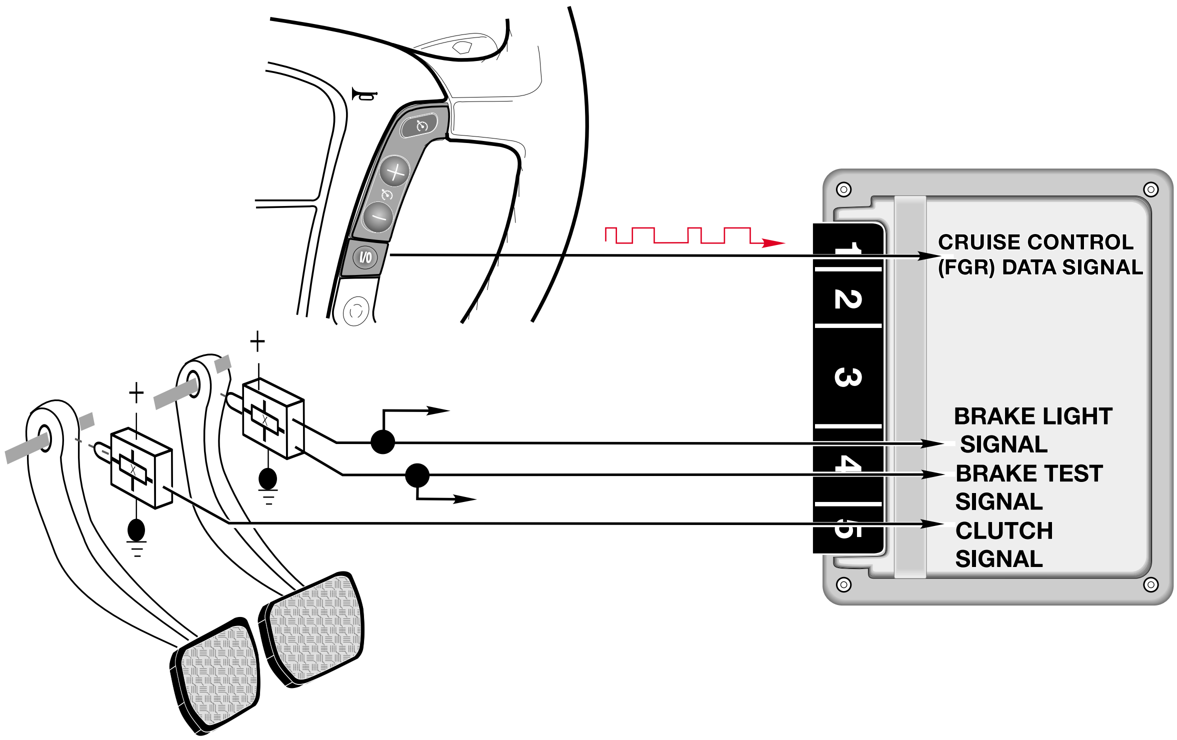
Additionally, ME 7.2 monitors all four wheel speed signals via CAN bus signalling to detect abrupt fluctuations in vehicle speed signals for the purpose of detecting rough road surfaces. This is continuously monitored as part of the OBD II emission requirements providing a correction factor for misfire detection plausibility. Earlier systems only monitored the right rear speed signal input from DSC.



MFL CRUISE CONTROL DATA SIGNAL

The ME 7.2 control module provides the FGR cruise control function. Throttle activation is provided by ME 7.2 automatic control of the EDK and monitoring of the throttle plate position feedback potentiometer signals.

All of the familiar driver requested cruise control function requests are provided to the ME 7.2 control module via the MFL control module on a single FGR data signal wire.



BRAKE LIGHT SWITCH

The Electronic Brake Switch (Hall effect) provides brake pedal position status to the ME 7.2. The control module monitors both the brake light and a separate brake light test switch circuits for plausibility.

When the brake pedal is pressed the brake light segment of the switch provides a ground signal. Simultaneously, the brake light test switch (located in the same housing) provides a high signal.

CLUTCH SWITCH

The clutch switch is equipped on manual transmission vehicles for deactivating the FGR. It is housed in the footwell by the clutch pedal. The hall effect clutch switch interrupts the single wire circuit to the ME 7.2 control module when the clutch pedal is pressed.

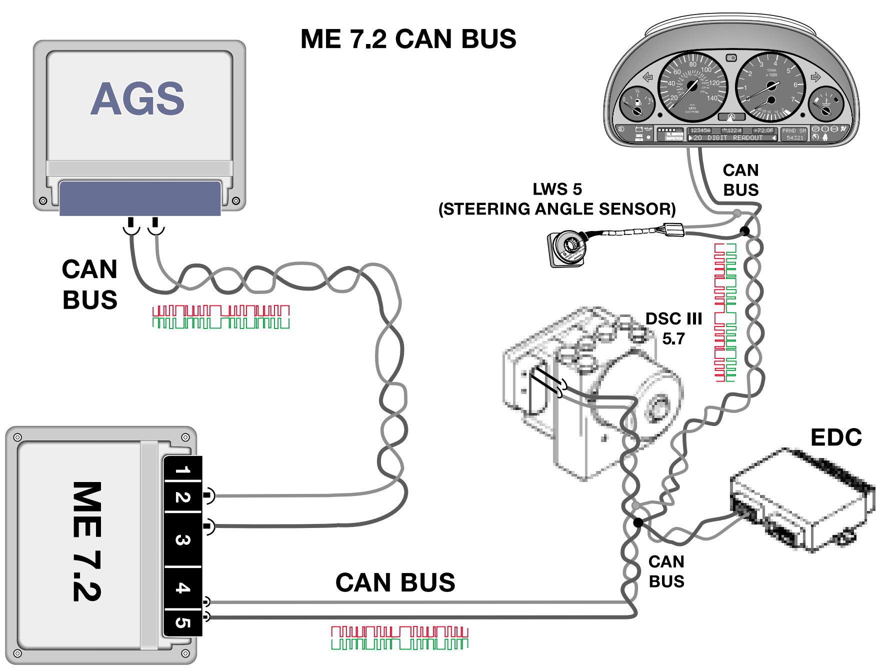
ME 7.2 CAN BUS TOPOLOGY

The CAN bus consists entirely of a twisted pair wire set. This configuration eliminates the need for a ground shield.

The Engine Control Module has two CAN bus communication ports, one dedicated to AGS and the other for the balance of the vehicle's CAN bus control modules.

This configuration improves the reliability of CAN bus signalling. If an open occurs in one area, the other control systems can still communicate on either side of the open.

However, signals not reaching their intended recipients will cause CAN bus faults to be stored in the affected systems.

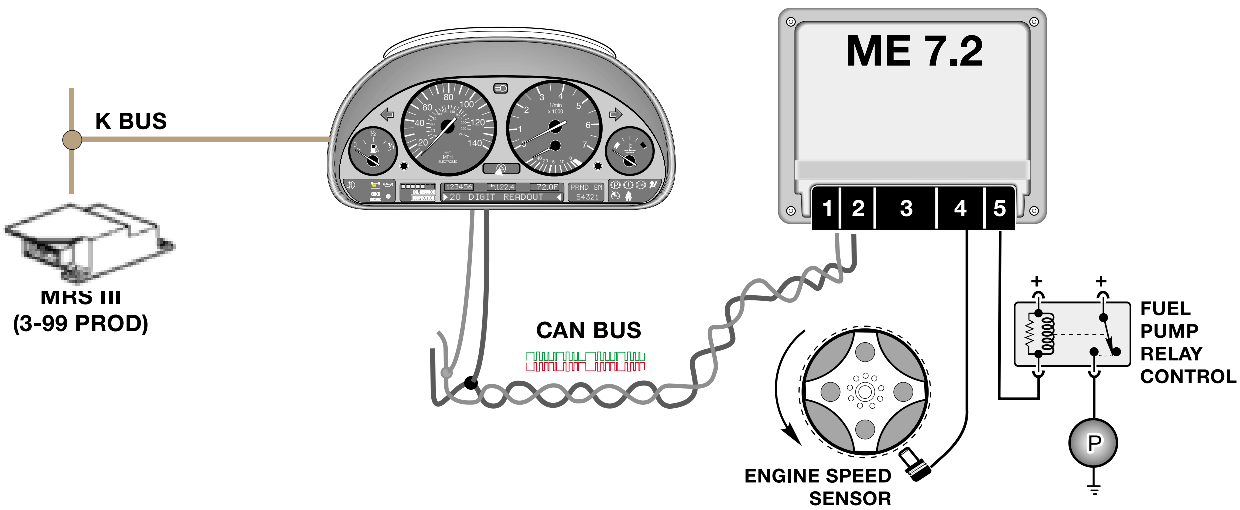


OUTPUT CONTROL FUNCTIONS/COMPONENTS

FUEL PUMP RELAY CONTROL

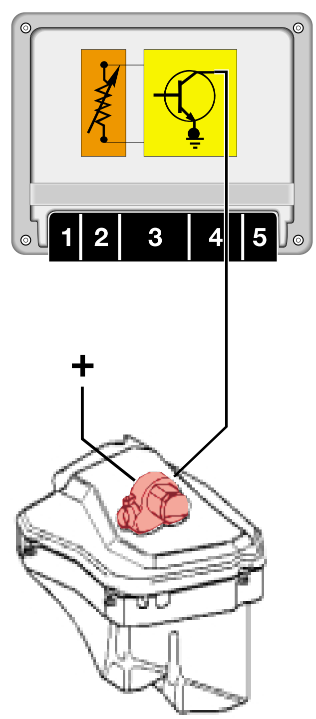
ME 7.2 controls the fuel pump relay as with previous systems with regard to engine speed input for continual activation of the relay.

When MRS III was incorporated into production (3-99) the ME 7.2 deactivates the fuel pump relay when an airbag is activated as an additional safety function.



E BOX FAN CONTROL

The E Box fan is controlled by ME 7.2. The control module contains an integral NTC temperature sensor for the purpose of monitoring the E box temperature and activating the fan.

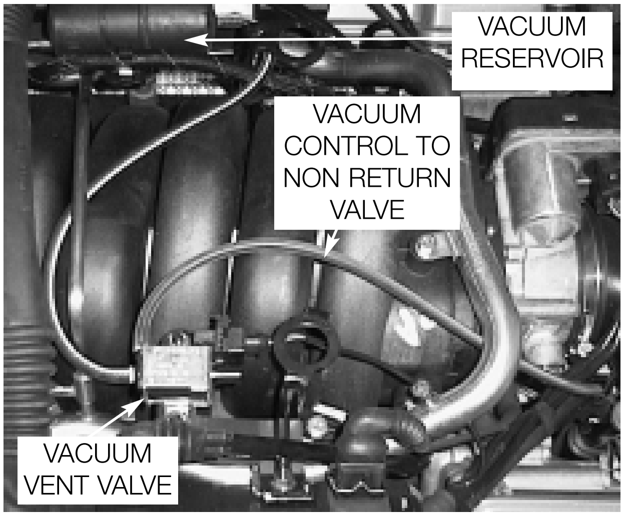


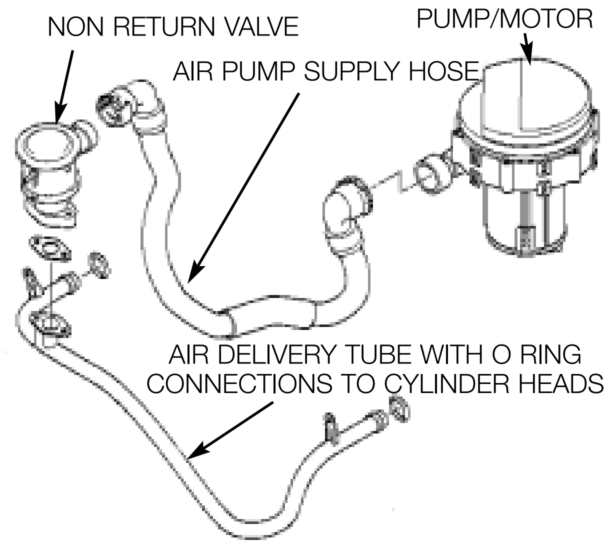
When the temperature in the E-Box exceeds predetermined values, ME 7.2 provides a switched ground for the E Box fan to cool the E box located control modules.

With every engine start-up, ME 7.2 briefly activates the fan ensuring continued fan motor operation for the service life of the vehicle. This feature is intended to prevent fan motor "lock up" from lack of use due to pitting or corrosion over time.

SECONDARY AIR INJECTION

The secondary air injection system is new to the 4.4 liter V8 engine. The system consists of the same components as previous systems with V8 specific locations.



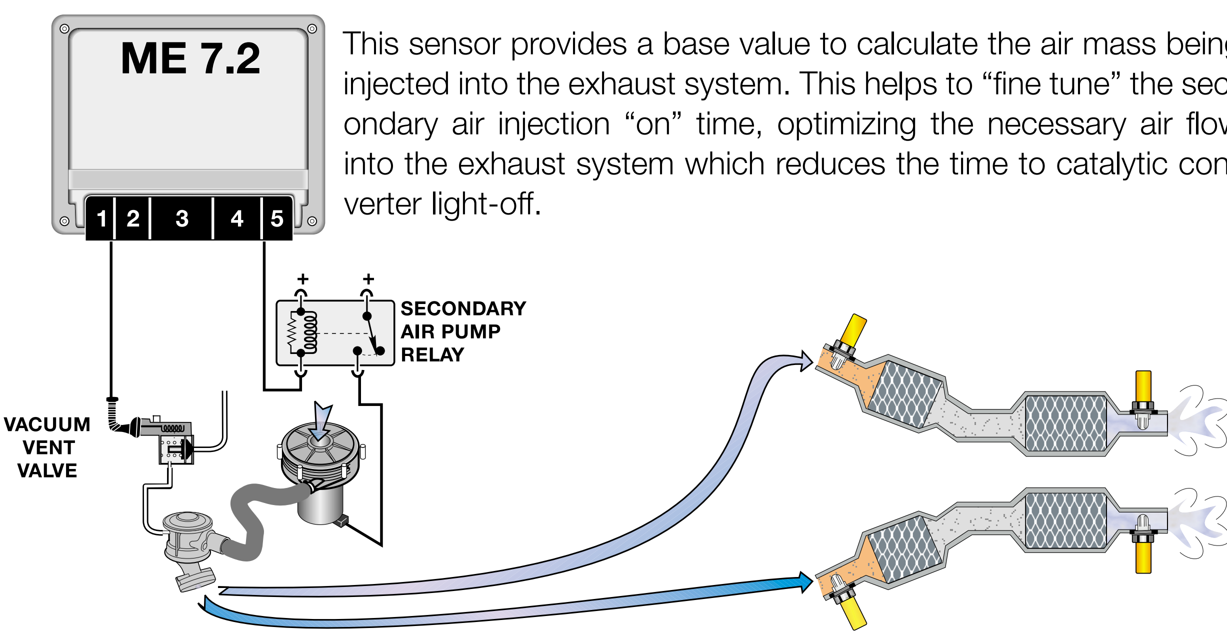


The ME7.2 control unit controls the vacuum vent valve and the secondary air injection pump relay separately but simultaneously.

The secondary air pump operates at a start temperature of between 10°C and 40°C. It continues to operate for a max. of 2 minutes at idle speed.

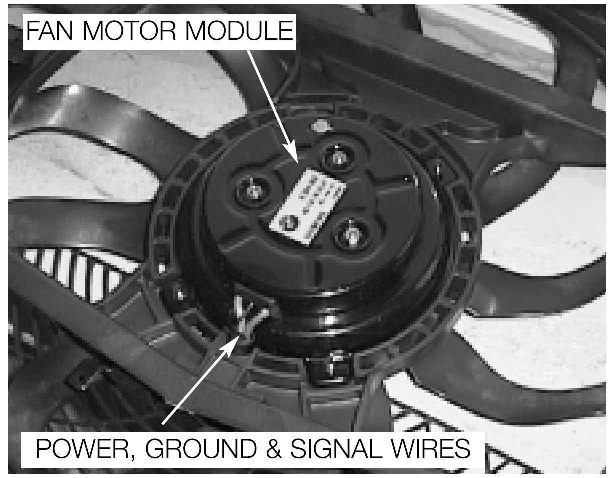
ME 7.2 contributes an additional correction factor for secondary air "on" time with the additional input from the integral ambient barometric pressure sensor.

This sensor provides a base value to calculate the air mass being injected into the exhaust system. This helps to "fine tune" the secondary air injection "on" time, optimizing the necessary air flow into the exhaust system which reduces the time to catalytic converter light-off.



AUXILIARY FAN CONTROL

The Auxiliary Fan motor incorporates an output final stage that activates the fan motor at variable speeds.

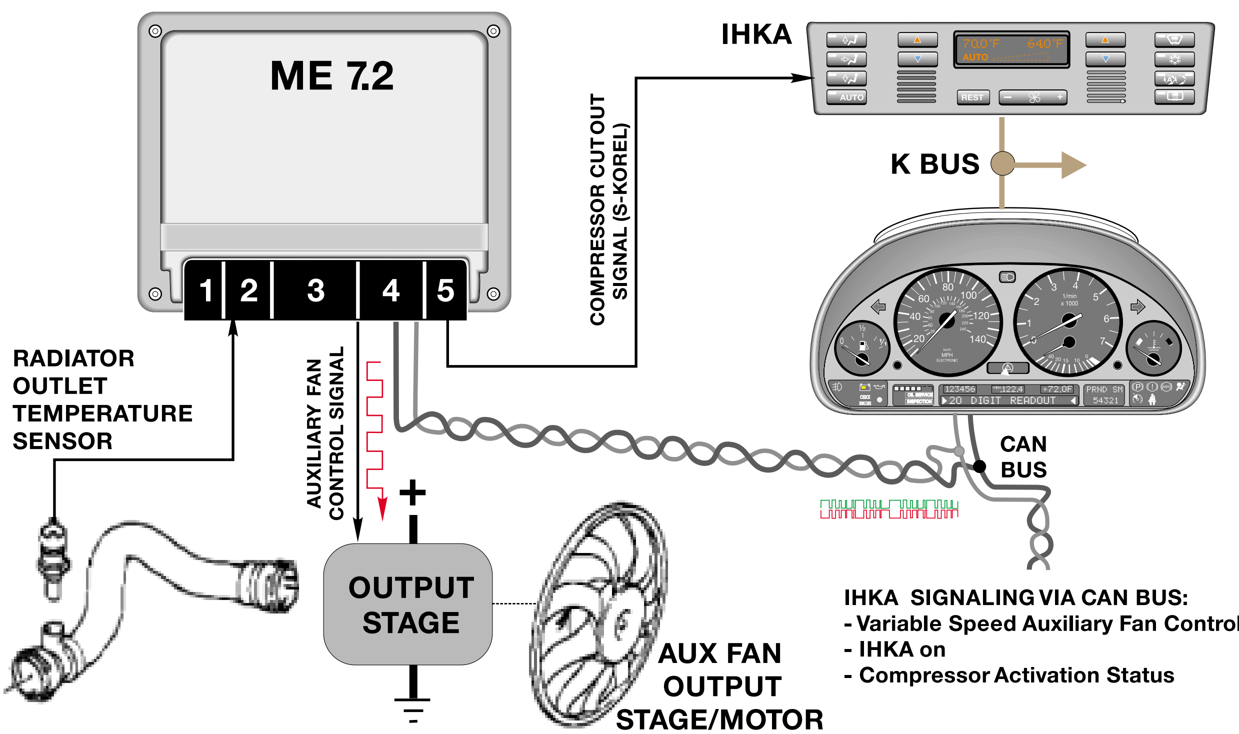


The auxiliary fan is controlled by ME 7.2. The motor output stage receives power and ground and activates the motor based on a PWM signal (10 - 100 Hz) received from the ME 7.2.

The fan is activated based on the following factors:

- Radiator outlet temperature sensor input exceeds a preset temperature.
- IHKA signalling via the K and CAN bus based on calculated refrigerant pressures.
- Vehicle speed
- Battery voltage level

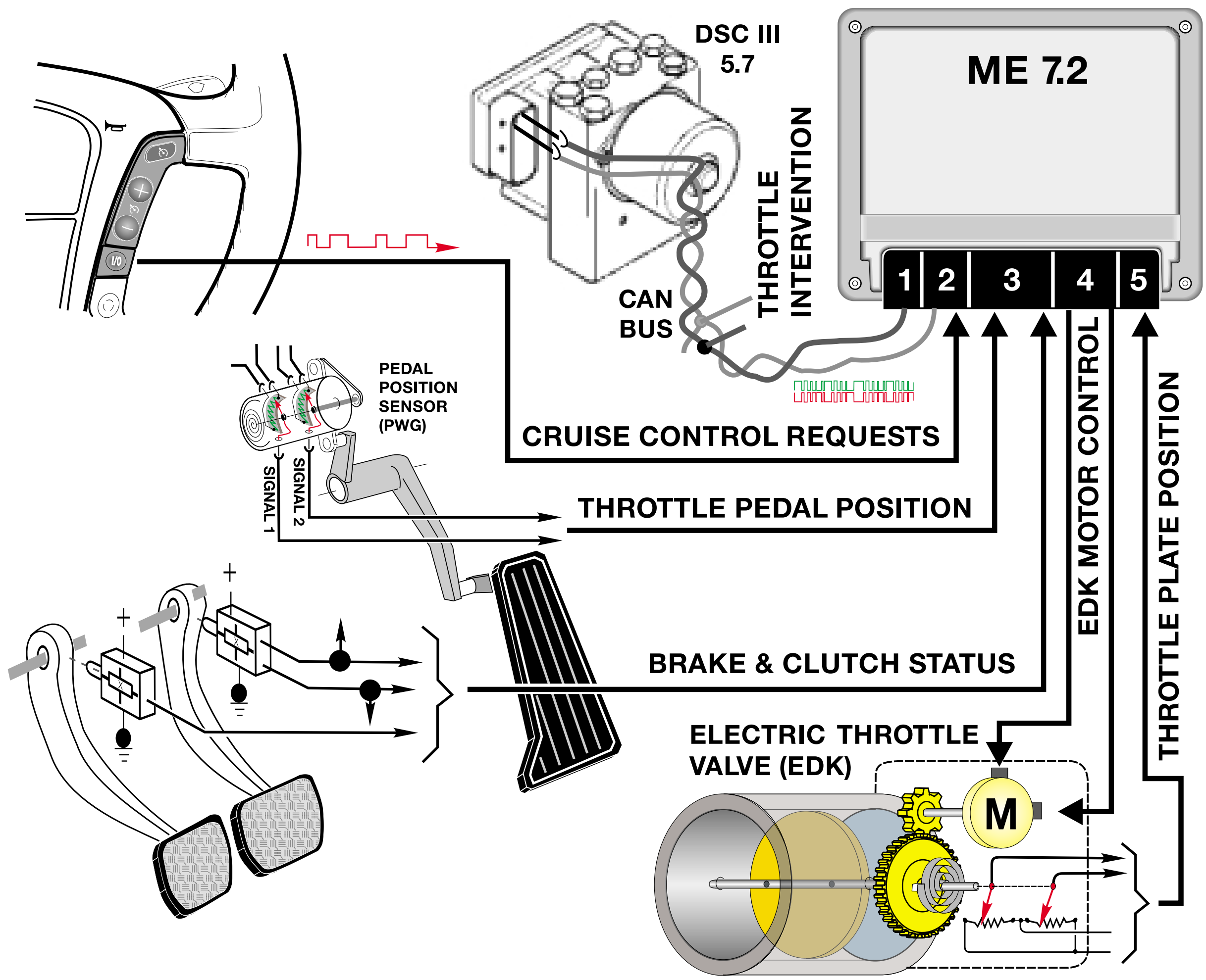
When the over temperature light in the instrument cluster is on (120°C) the fan is run in the overrun function. This signal is provided to the DME via the CAN bus. When this occurs the fan is run at a frequency of 10 Hz.



INTEGRAL ELECTRIC THROTTLE SYSTEM (EML)

FUNCTIONAL OVERVIEW

When the accelerator pedal is moved, the PWG provides a change in the monitored signals. The ME 7.2 compares the input signal to a programmed map and appropriately activates the EDK motor via proportional pulse width modulated control signals. The control module self-checks it's activation of the EDK motor via the EDK feedback potentiometers.

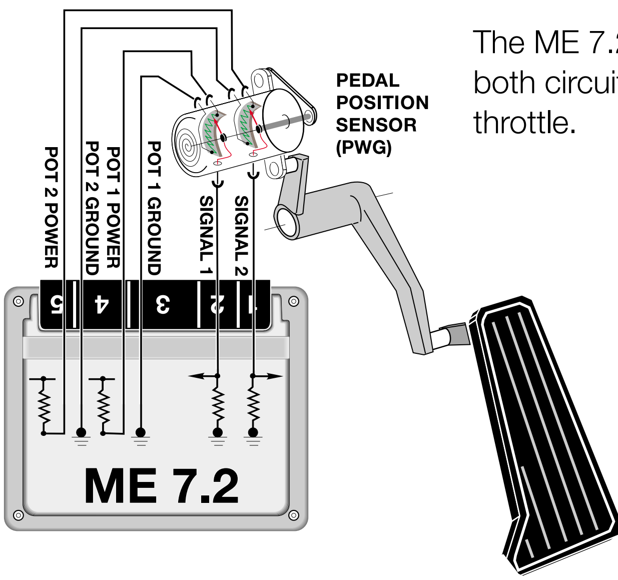


Requirements placed on the Electric Throttle System:

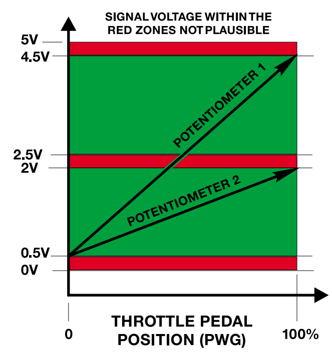
- Regulate the calculated intake air load based on PWG input signals and programmed mapping.
- Control idle air when LL detected with regard to roadspeed as per previous systems.
- Monitor the driver's input request for cruise control operation.
- Automatically position the EDK for accurate cruise control (FGR) operation.
- Perform all DSC III throttle control interventions.
- Monitor and carryout max engine and roadspeed cutout.

ACCELERATOR PEDAL SENSOR (PWG)

The driver's application of the accelerator pedal is monitored by a PWG sensor in the driver's footwell. The PWG provides two separate variable voltage signals to the ME 7.2 control module for determining the request for operating the Electric Throttle Valve (EDK) as well as providing a kickdown request with automatic transmission vehicles.



The ME 7.2 monitors the changing signal ranges of both circuits as the pedal is pressed from idle to full throttle.



- Standard transmission vehicles (E39 540i) have slightly lower voltage signals at max throttle position due to the throttle pedal stop (ie Pot 1 = 3.8volts). However, ME 7.2 programming recognizes the lower values of a standard transmission vehicle as the max throttle position.

- In vehicles equipped with an automatic transmission (A5S 440Z), the ME 7.2 recognizes the max pedal value (4.5V) as a kickdown request and signals the AGS via CAN bus.

PWG SIGNAL MONITORING & PWG FAILSAFE OPERATION:

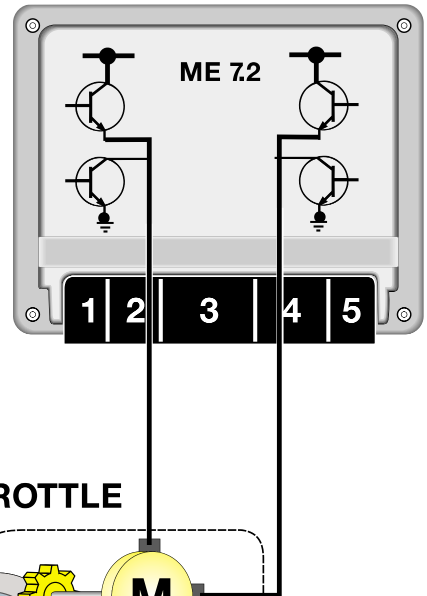
- If the monitored PWG potentiometer signals are not plausible, ME 7.2 will only use the lower of the two signals as the driver’s pedal request input providing failsafe operation. Throttle response will be slower and maximum throttle position will be reduced.

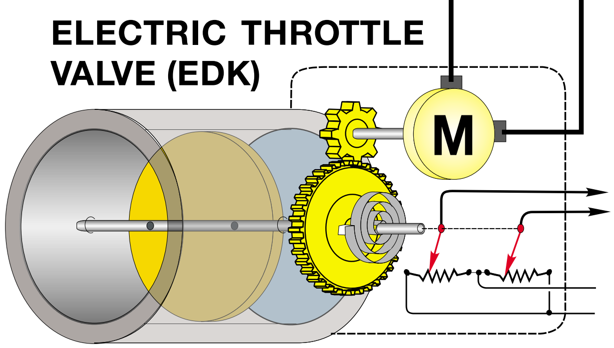
- When in PWG failsafe operation, ME 7.2 sets the EDK throttle plate and injection time to idle (LL) whenever the brake pedal is depressed.

- When the system is in PWG failsafe operation, the instrument cluster matrix display will post “Engine Emergency Program” and PWG specific fault(s) will be stored in memory.

ELECTRIC THROTTLE VALVE (EDK) CONTROL

- The throttle valve assembly of the M62 TU is an electric throttle valve (EDK) controlled by an integral EML function of the ME 7.2.
- The throttle plate is positioned by a gear reduction DC motor drive.
- The motor is controlled by proportionately switched high/low PWM signals at a basic frequency of 2000 Hz.
- Engine idle speed control is a function of the EDK. Therefore, the M62 TU does not require a separate idle control valve.

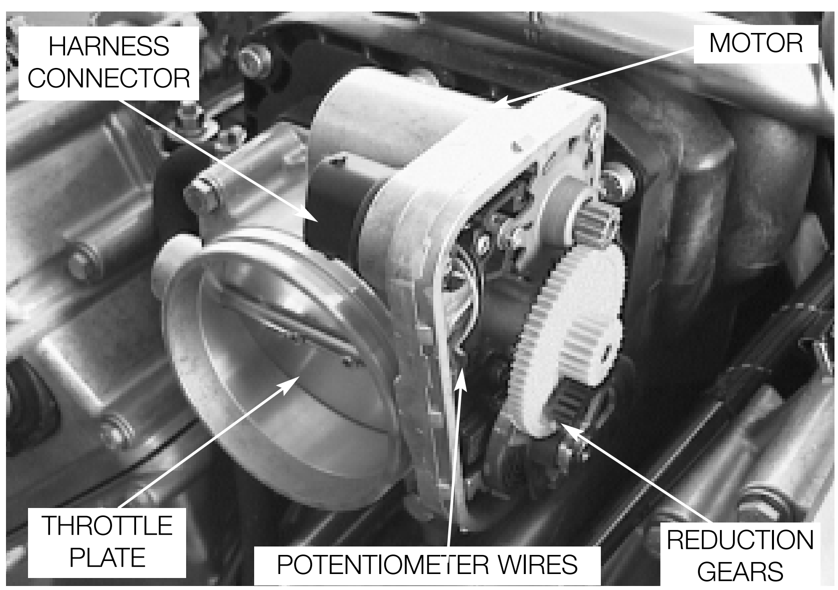




EDK ADAPTATION PROCEDURE:

When a replacement EDK is installed the adaptation values of the previous EDK must be cleared from the ME 7.2 control module.

1. From the Service Function Menu of the DIS/MoDiC, clear adaptation values.
2. Switch the ignition OFF for 10 seconds.
3. Switch the ignition ON (KL15). At approximately 30 seconds the EDK is briefly activated allowing the ME 7.2 to “electrically learn” the new component.

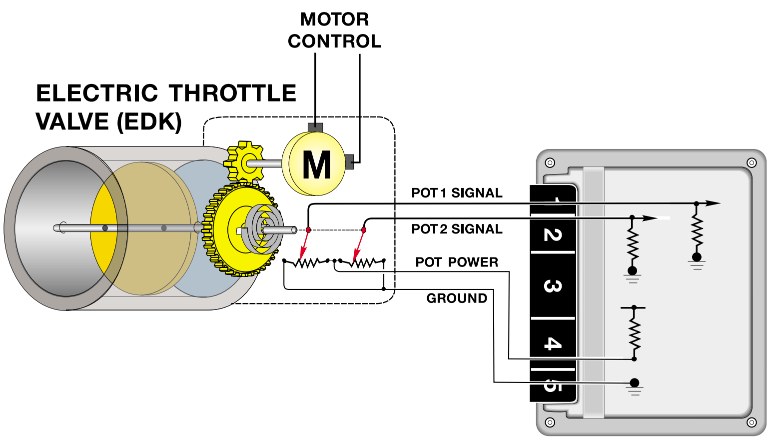


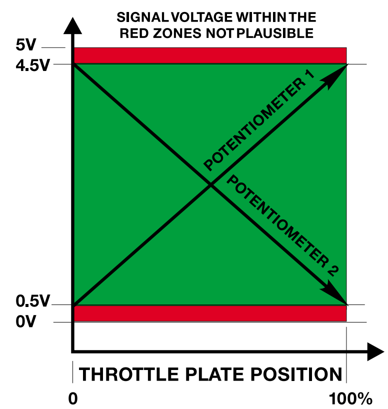
This procedure is also necessary after replacing an ME 7.2 control module. However, the adaptation values do not require clearing since they have not yet been established.

EDK THROTTLE POSITION FEEDBACK SIGNALS

The EDK throttle plate position is monitored by two integrated potentiometers. The potentiometers provide DC voltage feedback signals as input to the ME 7.2 for throttle and idle control functions.

Potentiometer signal 1 is the primary signal, Potentiometer signal 2 is used as a plausibility cross-check through the total range of throttle plate movement.





EDK FEEDBACK SIGNAL MONITORING & FAILSAFE OPERATION:

- If plausibility errors are detected between Pot 1 and Pot 2, ME 7.2 will calculate the inducted engine air mass (from HFM signal) and only utilize the potentiometer signal that closely matches the detected intake air mass.

  - The ME 7.2 uses the air mass signalling as a “virtual potentiometer” (pot 3) for a comparative source to provide failsafe operation.

  - If ME 7.2 cannot calculate a plausible conclusion from the monitored pots (1 or 2 and virtual 3) the EDK motor is switched off and fuel injection cut out is activated (no failsafe operation possible).

- The EDK is continuously monitored during all phases of engine operation. It is also briefly activated when KL15 is initially switched on as a “pre-flight check” to verify it’s mechanical integrity (no binding, appropriate return spring tension) by monitoring the motor control amperage and the reaction speed of the EDK feedback potentiometers.

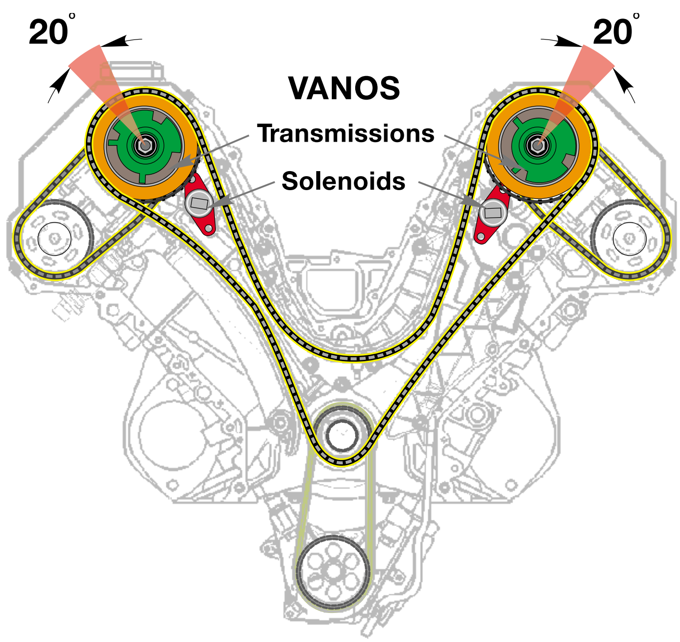
  If faults are detected the EDK motor is switched off and fuel injection cut off is activated (no failsafe operation possible). The engine does however continue to run extremely rough at idle speed.

M62 TU VANOS

OVERVIEW

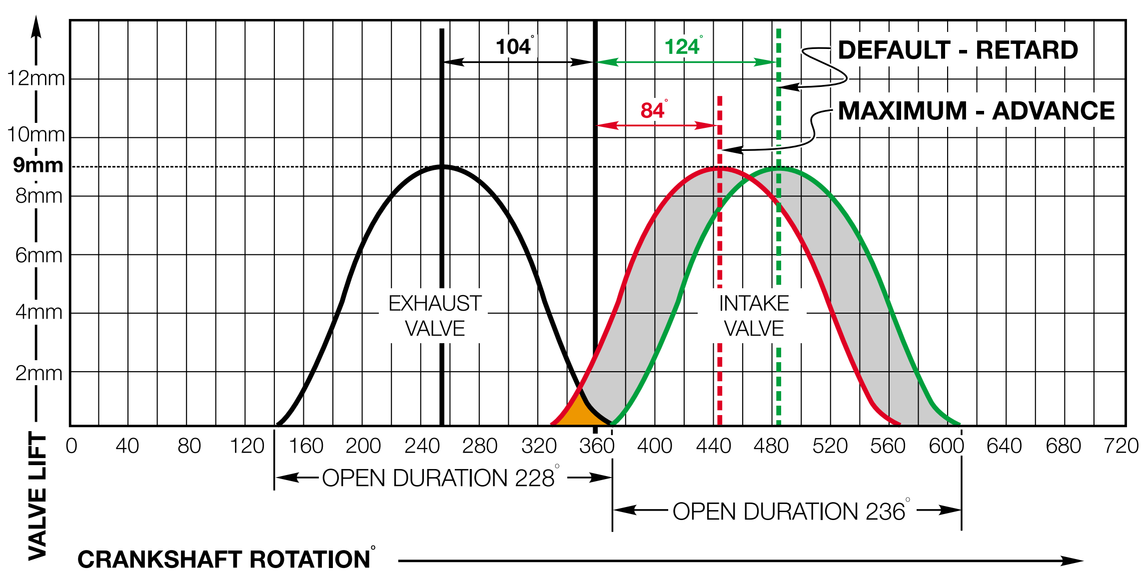
The M62 TU VANOS system provides stepless VANOS functionality on each intake camshaft. The system is continuously variable within its range of adjustment providing optimized camshaft positioning for all engine operating conditions.

While the engine is running, both intake camshafts are continuously adjusted to their optimum positions. This enhances engine performance and reduces tailpipe emissions.



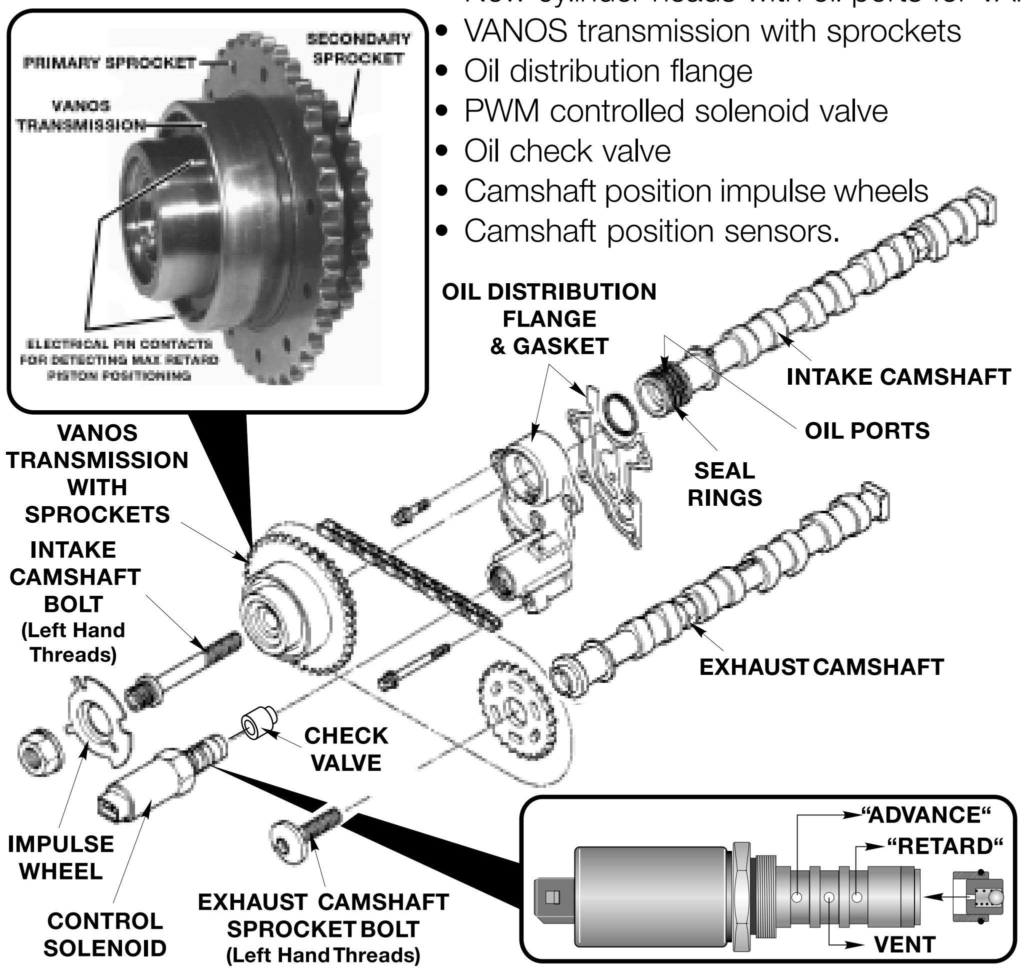
Both camshafts are adjusted simultaneously within 20° (maximum) of the camshafts rotational axis.

This equates to a maximum span of 40° crankshaft rotation. The camshaft spread angles for both banks are as follows.



M62 TU VANOS components include the following for each cylinder bank:

- New cylinder heads with oil ports for VANOS
- VANOS transmission with sprockets
- Oil distribution flange
- PWM controlled solenoid valve
- Oil check valve
- Camshaft position impulse wheels
- Camshaft position sensors.



VANOS CONTROL SOLENOID & CHECK VALVE: The VANOS solenoid is a two wire, pulse width modulated, oil flow control valve. The valve has four ports;

1. Input Supply Port - Engine Oil Supply
2. Input/Output Retard Port - Rear of piston/helical gear (retarded camshaft position)
3. Input/Output Advance Port - Front of piston/helical gear (advanced camshaft position)
4. Output Vent - Released oil

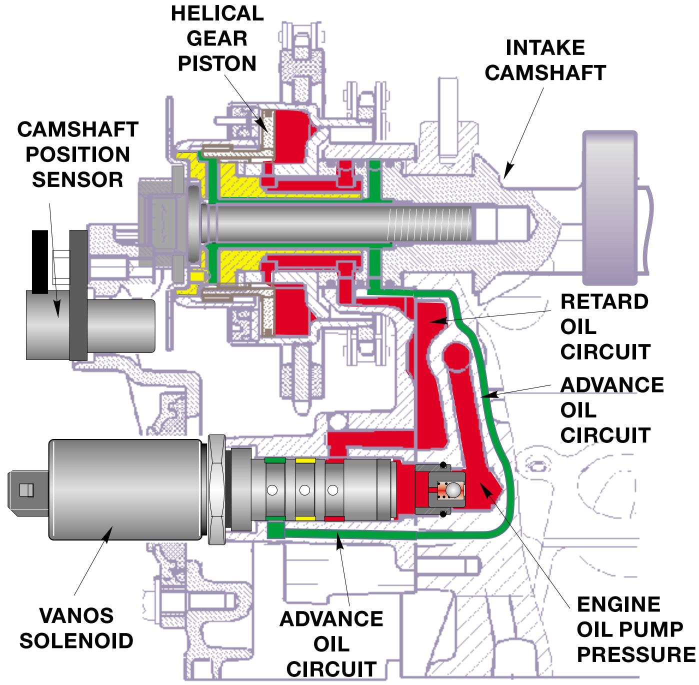
A check valve is positioned forward of the solenoid in the cylinder head oil gallery. The check valve retains oil in the VANOS transmission and oil circuits after the engine is turned off. This prevents the possibility of piston movement (noise) within the VANOS transmission system on the next engine start.

VANOS TRANSMISSION: The primary and secondary timing chain sprockets are integrated with the VANOS transmission. The transmission is a self-contained unit.

The controlled adjustment of the camshaft occurs inside the "transmission". Similar in principle to the six cylinder engine VANOS systems, controlled oil flow moves the piston.

The helical gear cut of the piston acts on the helical gears on the inside surface of the transmission and rotates the camshaft to the specific advanced or retarded angle position.

Three electrical pin contacts are located on the front surface to verify the default maximum retard position using an ohmmeter. This is required during assembly and adjustment.

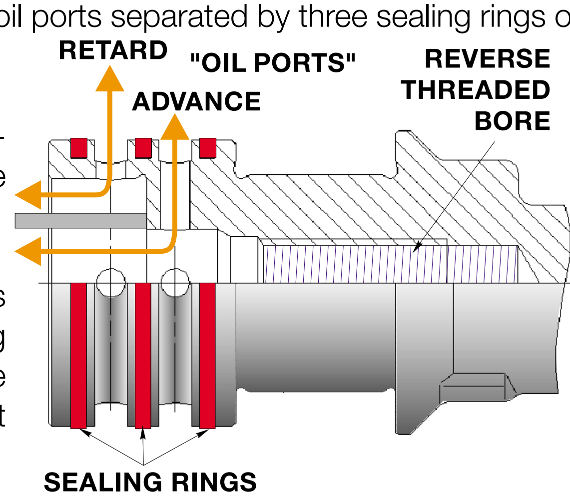


OIL DISTRIBUTION FLANGES: The oil distribution flanges are bolted to the front surface of each cylinder head. They provide a mounting location for the VANOS solenoids as well as the advance-retard oil ports from the solenoids to the intake camshafts.

CAMSHAFTS: Each intake camshaft has two oil ports separated by three sealing rings on their forward ends.

The ports direct the flow of oil from the oil distribution flange to the inner workings of the VANOS transmission.

Each camshaft has ***REVERSE*** threaded bores in their centers for the attachment of the timing chain sprockets on the exhaust cams and the VANOS transmissions for each intake camshaft as shown.

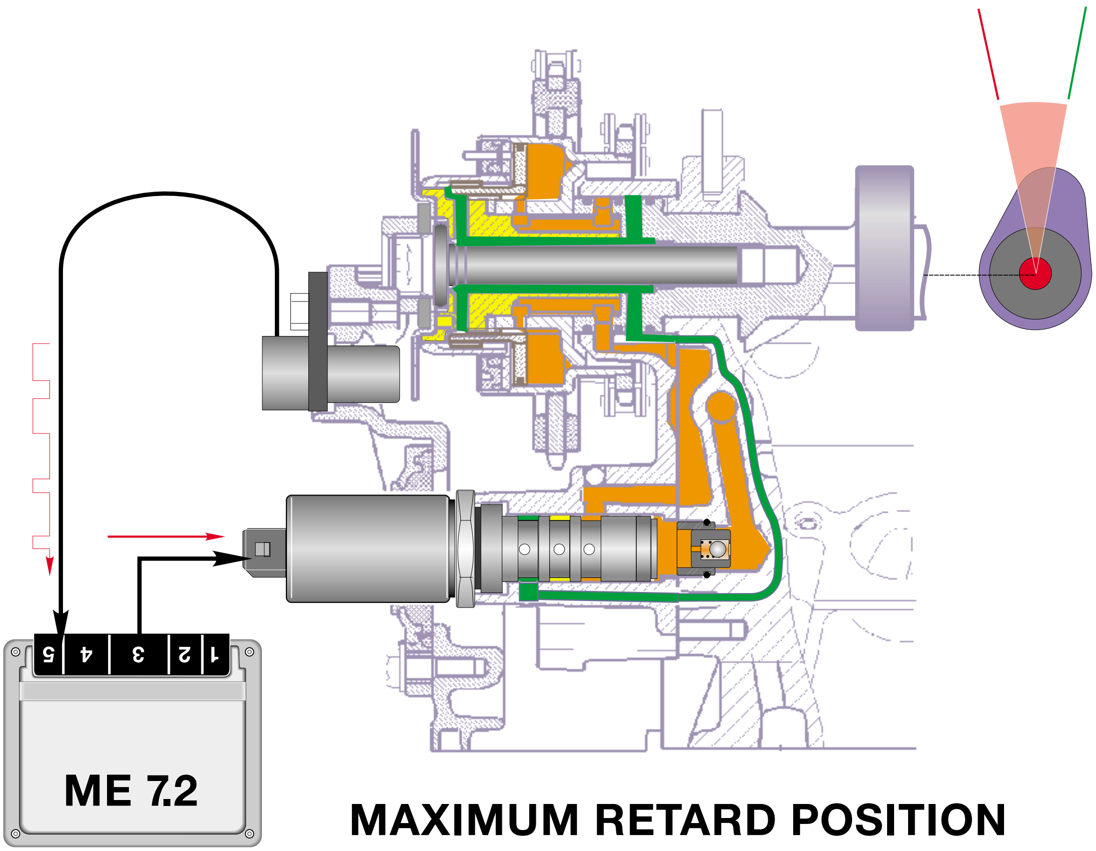


CAMSHAFT POSITION IMPULSE WHEELS: The camshaft position impulse wheels provide camshaft position status to the engine control module via the camshaft position sensors. The asymmetrical placement of the sensor wheel pulse plates provides the engine control module with cylinder specific position ID in conjunction with crankshaft position.

M62 TU VANOS CONTROL

As the engine camshafts are rotated by the primary and secondary timing chains, the ME7.2 control module activates the VANOS solenoids via a PWM (pulse width modulated) ground signal based on a program map. The program is influenced by engine speed, load, and engine temperature.

- **Shown below:** In the inactive or default position, the valves direct 100% engine oil flow to achieve max “retard” VANOS positioning.

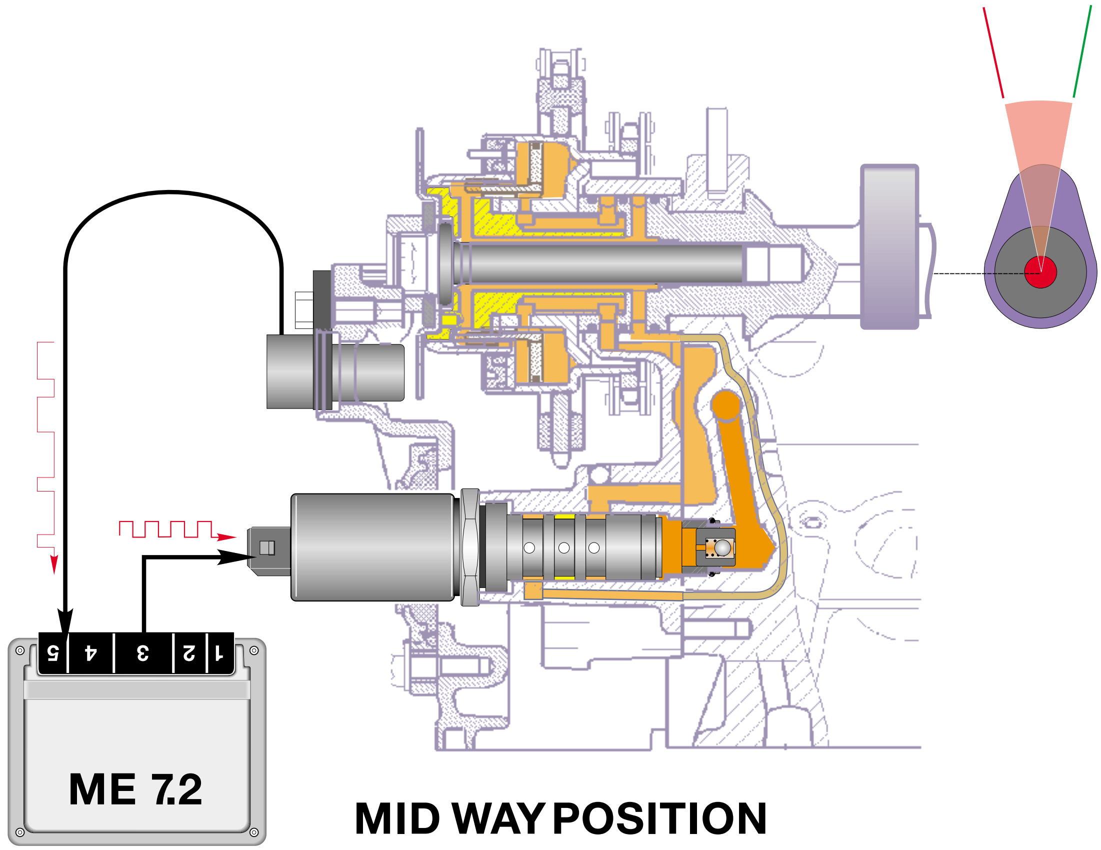


MAXIMUM RETARD POSITION

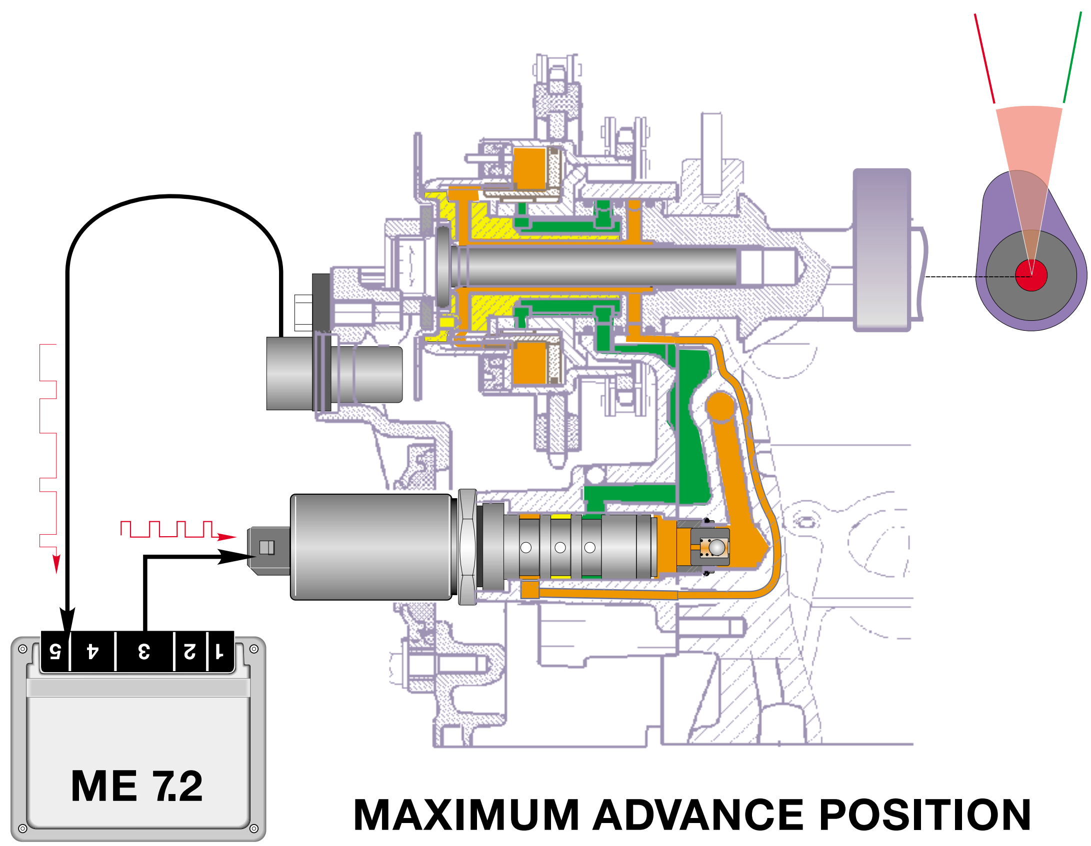
- **Top of next page**: As the Pulse Width Modulation (PWM) increases on the control signal, the frequency of on time increases and opens the advanced oil port more often. Oil flow pushes the piston toward the advance position. Simultaneously the oil flow on the retard side (rear) of the piston is proportionally decreased and directed to the vent port in the solenoid valve and drains into the cylinder head.

- **Bottom of next page:** At maximum PWM control, 100% oil flow is directed to the front surface of the piston pushing it rearward to maximum advance.

Varying the pulse width (on time) of the solenoids control signals proportionately regulates the oil flow on each side of the pistons to achieve the desired VANOS advance angle.



MID WAY POSITION



MAXIMUM ADVANCE POSITION

M62 TU CAMSHAFT POSITION SENSORS

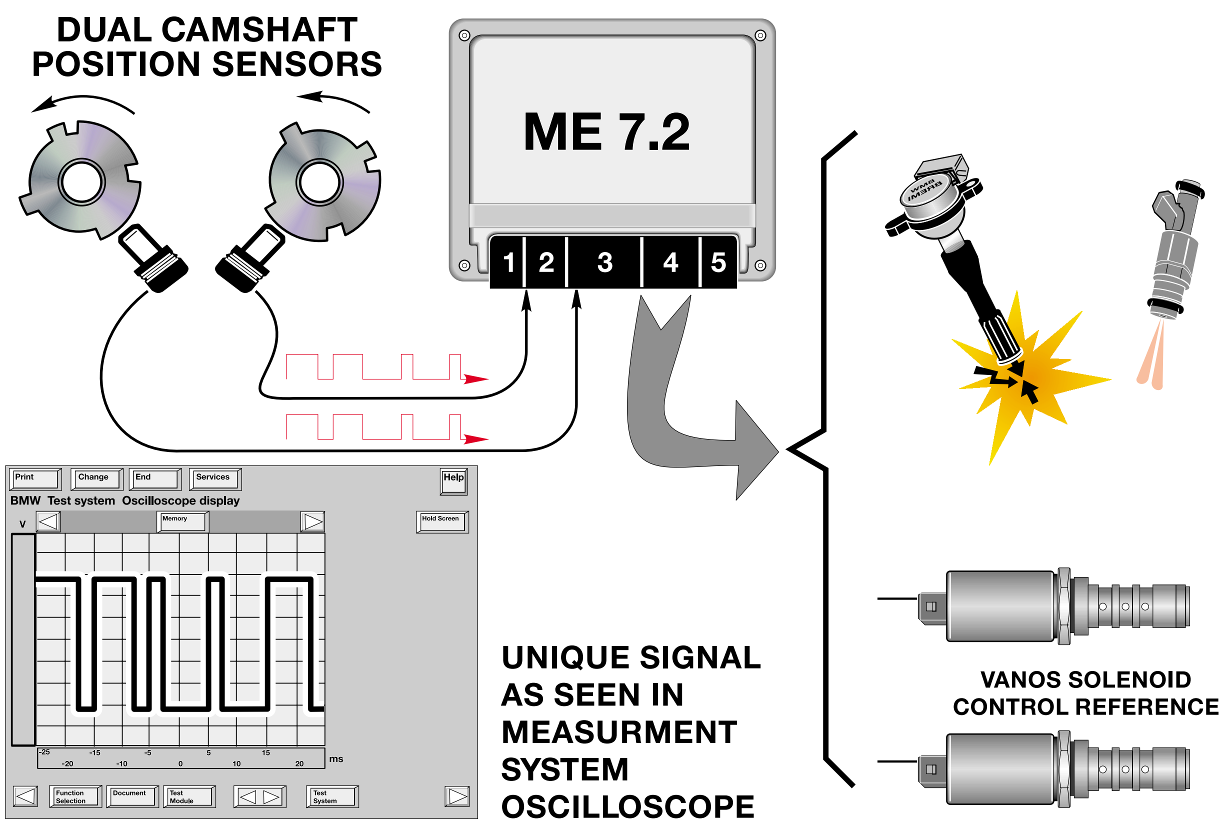
Located on the upper timing case covers, the camshaft position sensors monitor the position of the camshafts to establish start of ignition firing order, set up sequential fuel injection triggering and for accurate camshaft advance-retard (VANOS) timing feedback.

Each intake camshaft's advance-retard angles are adjusted simultaneously yet independently. For this reason ME 7.2 requires a camshaft position sensor on each cylinder bank for accurate feedback to monitor the VANOS controlled camshaft positioning.

The sensors are provided with operating power from the ECM relay. The sensors produce a unique asymmetrical square-wave signal representative of the impulse wheel shape. The sensors are new in the fact that they are "active" Hall effect sensors. Active Hall sensors provide:

- low signal when a tooth of the camshaft impulse wheel is located in front of the sensor
- high signal when an air gap is present.

The active hall sensors supply a signal representative of camshaft position even before the engine is running. The ME 7.2 determines an approximate location of the camshafts positions prior to engine start up optimizing cold start injection (reduced emissions.)



VANOS SERVICE NOTES

VALVE TIMING PROCEDURES

Refer to TIS for complete Valve Timing Procedures. M62 TU valve timing adjustment requires setting the VANOS transmissions to the max. retard positions with an ohmmeter and attaching the camshaft gears to each camshaft with single reverse threaded bolts.

- After locking the crankshaft at TDC, the camshaft alignment tools (P/N 90 88 6 112 440) are placed on the square blocks on the rear of the camshafts locking them in place.

- The exhaust camshaft sprockets and VANOS transmission units with timing chains are placed onto their respective camshafts.

- The exhaust camshaft sprockets and VANOS transmissions are secured to the camshafts with their respective single, reverse threaded bolt. Finger tighten only at this point. Install the chain tensioner into the timing chain case and tension the chain.

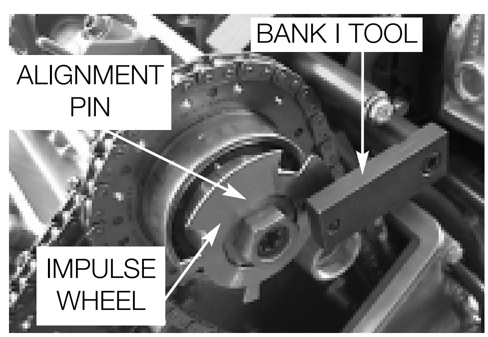
- Connect an ohmmeter across two of the three pin contacts on the front edge of one of the VANOS transmissions. Twist the inner hub of transmission to the left (counter clockwise). Make sure the ohmmeter indicates closed circuit. This verifies that the transmission in the default max retard position.

- Using an open end wrench on the camshaft to hold it in place, torque the VANOS transmission center bolt to specification.

CAMSHAFT IMPULSE WHEEL POSITION TOOLS

The camshaft impulse wheels require a special tool set to position them correctly prior to torquing the retaining nuts.

The impulse wheels are identical for each cylinder bank. The alignment hole in each wheel must align with the tool's alignment pin. Therefore the tools are different and must be used specifically for their bank.



The tool rests on the upper edge of the cylinder head and is held in place by the timing case bolts.

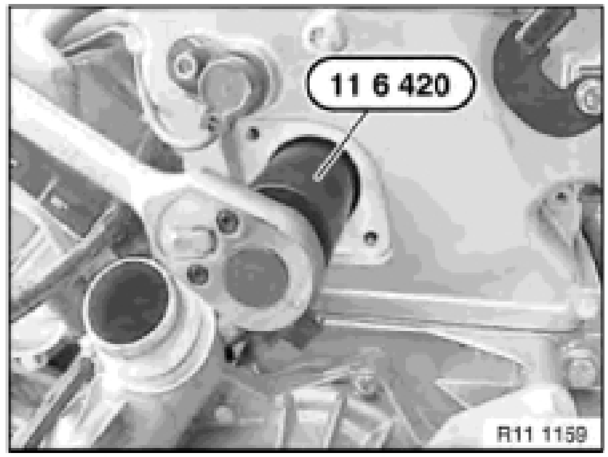
Refer to the TIS repair manual section for complete information.

VANOS SOLENOID REPLACEMENT

Refer to TIS repair manual section for complete solenoid replacement procedures.

The solenoids are threaded into the oil distribution flanges through a small opening in the upper timing case covers.

Special Tool 11 6 420 is required.

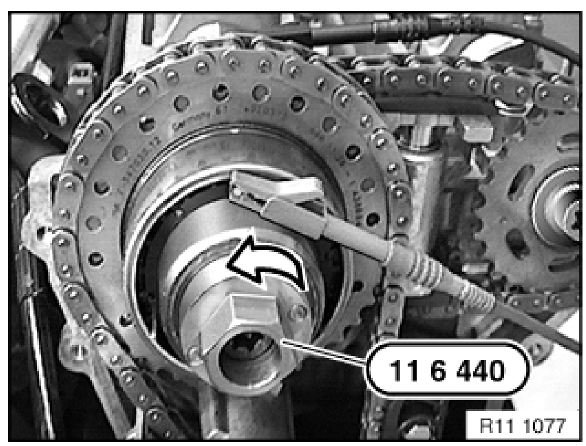


VANOS TRANSMISSION RETARD POSITION SET UP TOOLS

Special Tool 11 6 440 is used to rotate the transmission to the full retard position when checking the piston position with an ohmmeter.

This tool engages the inner hub of the transmission provides an easy method of twisting it to the left for the ohmmeter test.

Refer to SI Bulletin 04 12 98 for additional special tool information.



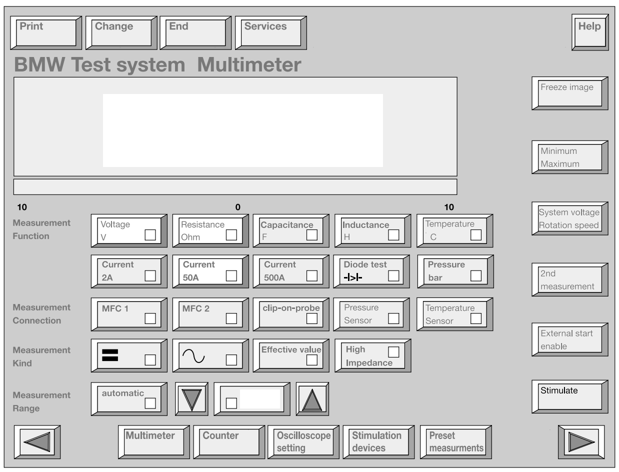
DIAGNOSIS

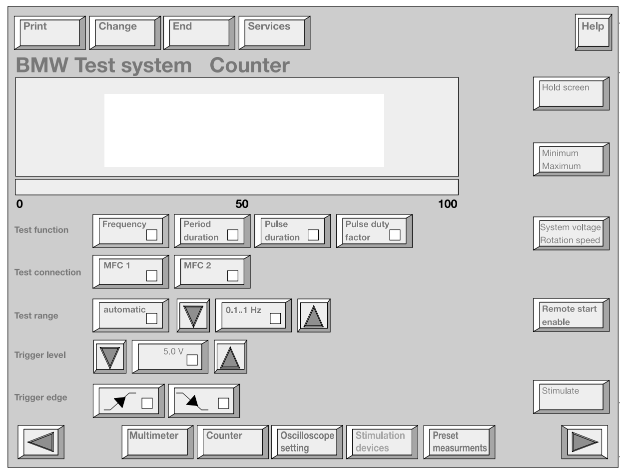
The VANOS is fully compatible with the diagnostic software providing specific fault codes and test modules. Additionally, diagnostic requests section provides status of the PWM of the VANOS solenoids and camshaft position feedback via the camshaft position sensors. The Service Functions section of the DIS/MoDiC also provides a VANOS system test.

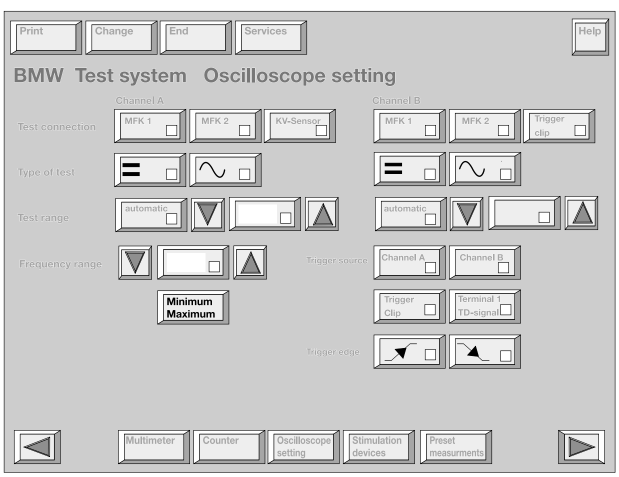
NAME OF SIGNAL OR FUNCTION: PWG Signals - ME 7.2

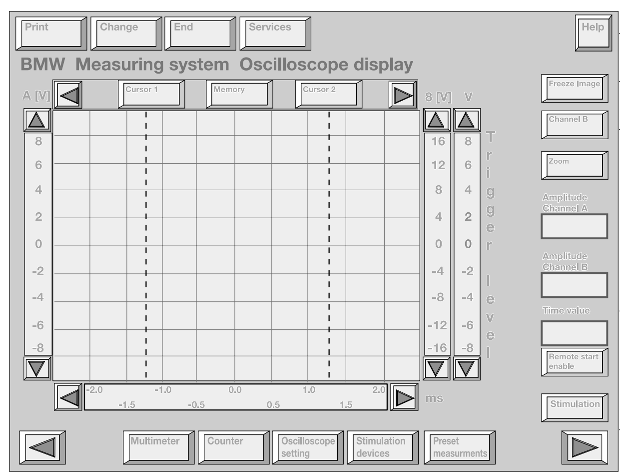
MEASUREMENT SYSTEM WORKSHEET: While connecting and setting up the DIS/ MoDiC measument system for signal/circuit validation, note the settings in the approriate locations for future reference. Document your findings by entering the displayed values in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.

Vehicle: **M.Y.:** **DIS CD Version:**









MEASUREMENT SYSTEM WORKSHEET: While connecting and setting up the DIS/MoDiC measurement system for signal/circuit validation, note the settings in the appropriate locations for future reference. Document your findings by entering the displayed values in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.

NAME OF SIGNAL OR FUNCTION: ____________________

Vehicle: __________ **M.Y.:** ______ **DIS CD Version:** __________

What type of signal is this? ☐ Switched Power ☐ Switched Ground ☐ Pulse Width Modulated (PWM)

☐ Linear Voltage ☐ Linear Resistance ☐ Digital ☐ Other: ____________________

How will the control system react if this signal becomes impaired or lost ?

____

____

____

Is there a substitute value for this signal? ☐ Yes ☐ No

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

Does signal status display or the component activation functions help you with diagnosis? ☐ Yes ☐ No **Why?** ____________________

____

____

____

____

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: ____________________ **Nominal Value(s)?:** ____________________

Notes:

____

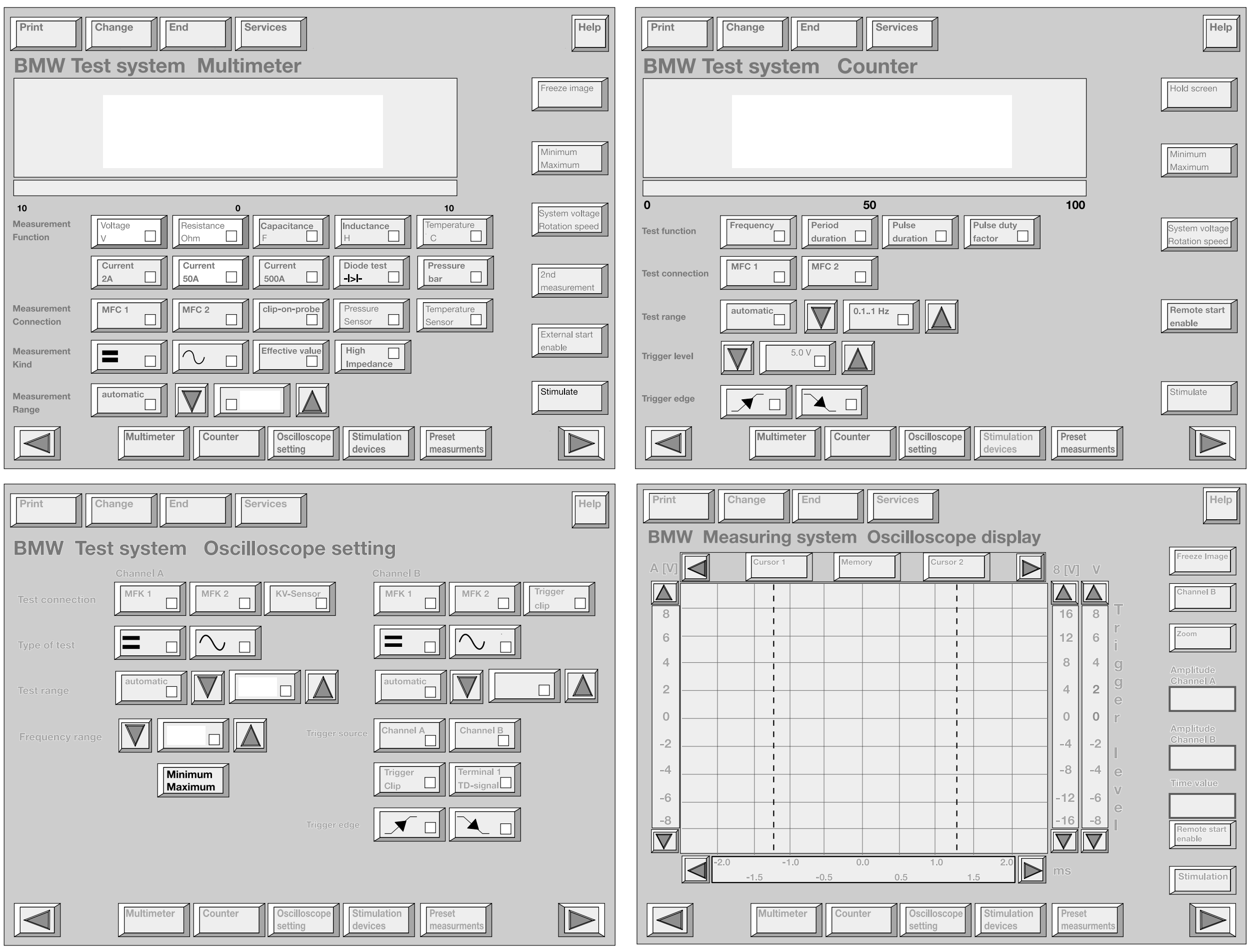
____

____

____

NAME OF SIGNAL OR FUNCTION: *EDK Control -- ME 7.2*

MEASUREMENT SYSTEM WORKSHEET: While connecting and setting up the DIS/MoDiC measument system for signal/circuit validation, note the settings in the appropriate locations for future reference. Document your findings by entering the displayed values in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.



MEASUREMENT SYSTEM WORKSHEET: While connecting and setting up the DIS/MoDiC measurement system for signal/circuit validation, note the settings in the appropriate locations for future reference. Document your findings by entering the displayed values in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.

NAME OF SIGNAL OR FUNCTION:

Vehicle: __________ **M.Y.:** ______ **DIS CD Version:** ______________

What type of signal is this? ☐ Switched Power ☐ Switched Ground ☐ Pulse Width Modulated (PWM)

☐ Linear Voltage ☐ Linear Resistance ☐ Digital ☐ Other: ______________________

How will the control system react if this signal becomes impaired or lost ?

____

____

____

Is there a substitute value for this signal? ☐ Yes ☐ No

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

Is “component activation” possible with this signal/function? ☐ Yes ☐ No

Does signal status display or the component activation functions help you with diagnosis? ☐ Yes ☐ No **Why?** ______________________

____

____

____

____

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: ____________________ **Nominal Value(s)?:** ____________________

Notes:

____

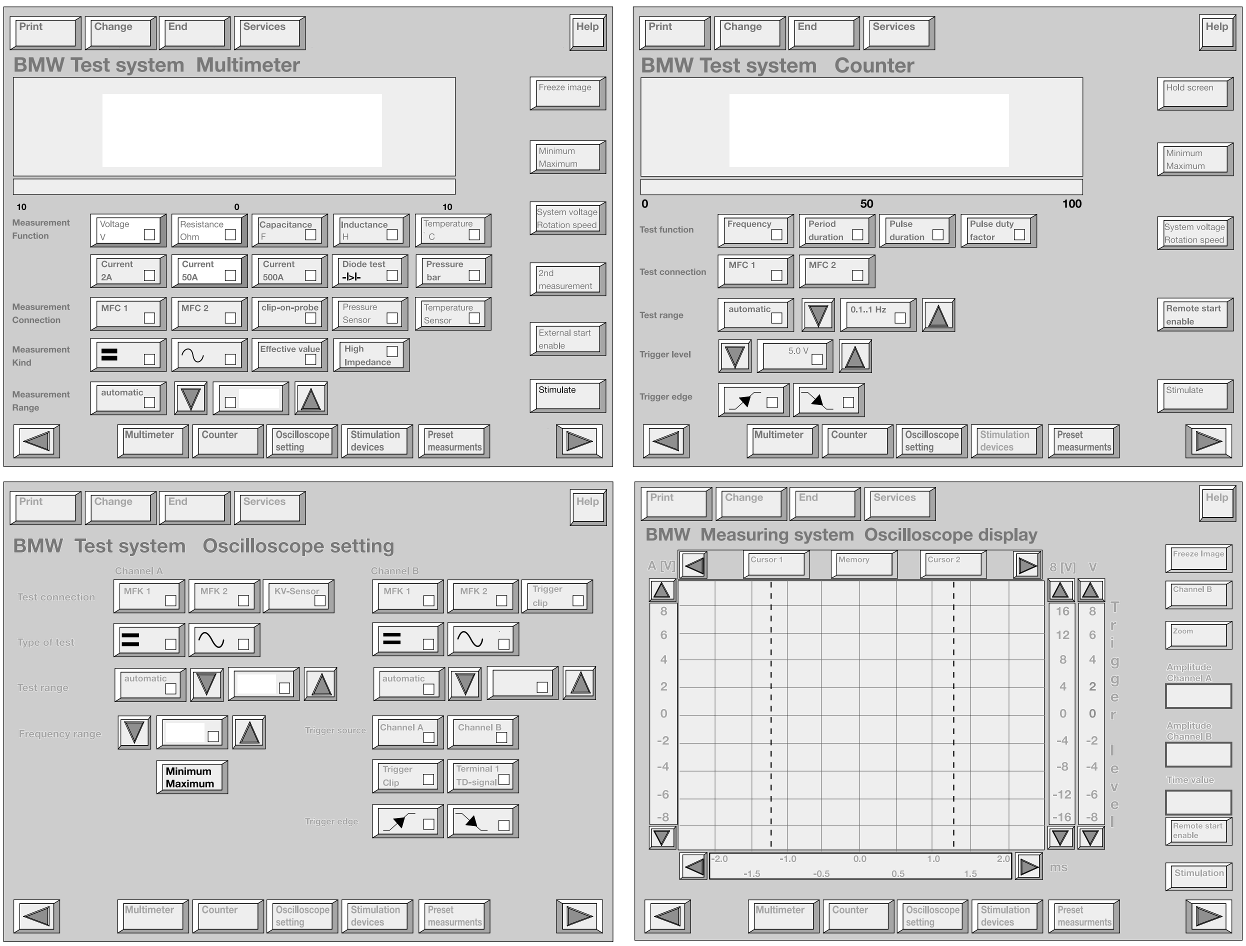
____

____

____

NAME OF SIGNAL OR FUNCTION: *EDK Feedback Potentiometers*

MEASUREMENT SYSTEM WORKSHEET: While connecting and setting up the DIS/MoDiC measument system for signal/circuit validation, note the settings in the appro-riate locations for future reference. Document your findings by entering the displayed val-ues in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.



MEASUREMENT SYSTEM WORKSHEET: While connecting and setting up the DIS/MoDiC measurement system for signal/circuit validation, note the settings in the appropriate locations for future reference. Document your findings by entering the displayed values in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.

NAME OF SIGNAL OR FUNCTION: ______________________

Vehicle: __________ **M.Y.:** ______ **DIS CD Version:** ____________

What type of signal is this? ☐ Switched Power ☐ Switched Ground ☐ Pulse Width Modulated (PWM)

☐ Linear Voltage ☐ Linear Resistance ☐ Digital ☐ Other: ______________________

How will the control system react if this signal becomes impaired or lost ?

____

____

____

Is there a substitute value for this signal? ☐ Yes ☐ No

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

Does signal status display or the component activation functions help you with diagnosis? ☐ Yes ☐ No **Why?** ______________________

____

____

____

____

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: ______________ **Nominal Value(s)?:** ______________

Notes:

____

____

____

NAME OF SIGNAL OR FUNCTION: *VANOS Solenoid Control*

Vehicle: **M.Y.:** **DIS CD Version:** ____________

What type of signal is this ? ☐

How will the control system react if this signal becomes impaired or lost ?

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? ______________________________

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

Is there a Test Function selection to test this system? ☐ Yes ☐ No

If yes what does it do? ______________________________

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** ____________

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: ________ **Nominal Value?:** ____________

MEASUREMENT SYSTEM WORKSHEET: While connecting and setting up the DIS/MoDiC measurement system for signal/circuit validation, note the settings in the appropriate locations for future reference. Document your findings by entering the displayed values in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.

NAME OF SIGNAL OR FUNCTION: ______________________

Vehicle: __________ **M.Y.:** ______ **DIS CD Version:** ____________

What type of signal is this? ☐ Switched Power ☐ Switched Ground ☐ Pulse Width Modulated (PWM)

☐ Linear Voltage ☐ Linear Resistance ☐ Digital ☐ Other: ____________

How will the control system react if this signal becomes impaired or lost ?

____

____

____

Is there a substitute value for this signal? ☐ Yes ☐ No

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

Does signal status display or the component activation functions help you with diagnosis? ☐ Yes ☐ No **Why?** ______________________

____

____

____

____

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: ______________ **Nominal Value(s)?:** ______________

Notes:

____

____

____

NAME OF SIGNAL OR FUNCTION: *Camshaft Position Sensor Signals*

Vehicle: **M.Y.:** **DIS CD Version:** ____________

What type of signal is this ? ☐

How will the control system react if this signal becomes impaired or lost ?

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? ____________

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

Is there a Test Function selection to test this system? ☐ Yes ☐ No

If yes what does it do? ____________

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** ____________

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

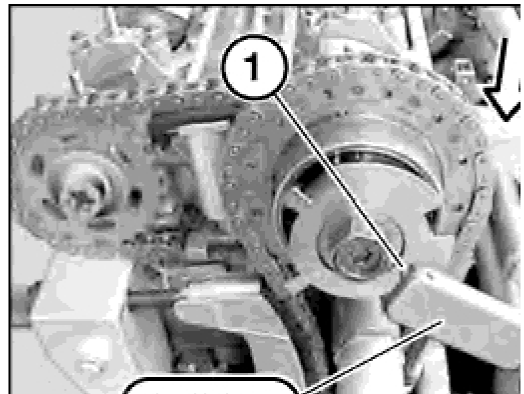
Signal Range?: ________ **Nominal Value?:** ____________

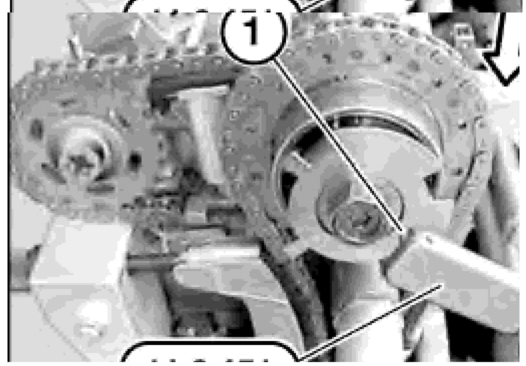
Repair Manual Worksheet : *Adjusting Camshaft Timing (M62 TU)*

Vehicle: ______ **M.Y.:** ______ **TIS CD Version:** ____________

What Main Group/Sub Group is this procedure found in ? ____________________

Identify and list all the special tools (with P/N) required for this procedure:





What is the purpose of the special tool shown in the illustration?

Why is it necessary to use an ohmeter to adjust the valve timing?

In your own words, list the steps required to carry out this procedure (breif)

What components require a torque wrench when tightening?

Review Questions

1. What does the “ME” designation identify?

2. Is ORVR monitored by the ECM?

3. What is the ECM monitoring from the LDP Pump during Operation?

4. Describe the Non-Return Fuel Rail System:

5. What is the purpose of the Radiator Outlet Temperature Sensor?

6. What two systems affect the Fuel Pump operation?

7. When in PWG failsafe operation, what is the effect when the brake pedal is depressed?

8. The EDK throttle plate position monitoring has two voltage signals, what is the voltage range of each as the throttle plate is opened?

9. Active Hall sensors (monitoring the camshafts) provide two types of signals, low and high. What conditions are present that produce a:

   - Low Signal
   - High Signal

10. What is the Special Tool Set number for VANOS adjustment?

11. The EDK Adaptation Proceedure requires three steps that include: